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Research Article

Treatment of perforation after endoscopic retrograd cholangiopancreatography

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ABSTRACT

Introduction: Endoscopic retrograde cholangiopancreatography (ERCP) is a frequently performed invasive procedure associated with serious complications. While the rate of ERCP-related perforation is approximately 1%, the associated mortality rate can be as high as 8%. These perforations are categorized based on the Stapfer classification. Type I refers to duodenal perforations, Type II to periampullary perforations, Type III to perforations of the biliary system or pancreatic duct, and Type IV to the presence of retroperitoneal free air.

Methods: In our retrospective study, we analyzed patients who were consulted for post-ERCP perforation at our clinic over a five-year period. Treatment decisions were made jointly by the performing gastroenterologist and an experienced hepatobiliary surgeon. Conservative management included nil per os (NPO), close monitoring of laboratory and physical examination findings, and administration of intravenous fluids and antibiotics.

Results: A total of 35 patients were included in the study. The mean follow-up period was 12.7 days. Six patients who were clinically and biochemically unstable underwent surgery; two of these had Type I perforations and four had Type II perforations. Of the 29 patients managed conservatively, 26 were discharged in good health.

Conclusion: The necessity for surgical intervention in patients with post-ERCP perforation is a critical determinant of prognosis. The requirement for surgery and the subsequent high rates of mortality and morbidity in Type I and Type II perforations indicate the need for a more aggressive treatment strategy for these types. Conversely, conservative treatment appears to yield successful outcomes in patients with Type III and Type IV perforations. Therefore, an approach based on the Stapfer classification plays a significant role in the management of these patients.

Keywords: ercp, perforation, stapfer, endoscopy

Introduction

Endoscopic retrograde cholangiopancreatography (ERCP) is a procedure associated with significant complications, including pancreatitis, hemorrhage, cholangitis, and duodenal perforation. The perforation rate is reported to range from 0.095% to 1.676%, with modern data indicating a mortality rate of up to 8%. ERCP perforations are associated with factors such as sphincterotomy, prolonged procedure duration, advanced age, and a history of repeated procedures. It has been

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observed that patients do not follow a uniform clinical course and present with heterogeneous findings. While intraperitoneal perforations are an indication for surgery, the management of retroperitoneal perforations remains a subject of debate (1). Mortality is often linked to delays in diagnosis and treatment (2).

In our study, we analyzed patients who developed post-ERCP perforations and compared their clinical status with findings reported in the literature.

Materials and Methods

In this retrospective study, patients who were consulted at the general surgery clinic of our hospital between 2018 and 2023 for post-ERCP perforation were evaluated. All patients who developed post-ERCP perforation and were consulted by the general surgery department during the study period were included. No patients were excluded due to being followed up in isolation by the gastroenterology department or having incomplete records. The included patients were analyzed for demographic data such as age, gender, and comorbidities, as well as ERCP indications, perforation type (Stapfer classification Types I–IV), time and methods of diagnosis, imaging findings, clinical symptoms, applied treatment algorithms, and clinical outcomes. Data were collected from patient files and the hospital information system using a standardized form. Perforations were classified according to the description by Stapfer et al (3). Type I perforation refers to perforation of the medial or lateral duodenal wall caused by the endoscope; Type II perforations are periampullary perforations associated with sphincterotomy; Type III perforations involve the biliary tree or pancreatic duct; and Type IV perforations refer to retroperitoneal free air. Perforations were mostly detected post-procedurally. Patients who developed abdominal pain after ERCP and were suspected of having a perforation underwent intravenous contrast-enhanced abdominal computed tomography (CT). The diagnosis was established based on clinical and imaging findings. The treatment decision was made through a multidisciplinary approach by the performing gastroenterologist and an experienced hepatobiliary surgeon. The decision algorithm for surgical and conservative treatment is summarized in Table 1.

The treatment decision was made jointly by the performing gastroenterologist and an experienced hepatobiliary surgeon. Conservative management included nil per os (NPO), daily monitoring of laboratory values and physical examination, and administration of intravenous fluids and antibiotics.

The following clinical parameters were examined and recorded using standard forms:

- Time of Diagnosis: Intraoperative, early postoperative (<24 hours), and late (>24 hours)
- Diagnostic Methods: CT, plain radiography, endoscopic findings, clinical examination

Table 1. Decision algorithm for treatment approach

Parameter	Indication for Conservative Treatment	Indication for Surgical Treatment
Clinical Status	Hemodynamic stability, localized pain, no signs of peritonitis	Hemodynamic instability, generalized peritonitis, progression to sepsis
Laboratory	Stable or decreasing inflammatory markers (Leukocyte, CRP)	High and increasing inflammatory markers
Radiology (CT)	Minimal retroperitoneal air/fluid, no contrast extravasation	Widespread pneumoperitoneum, abscess/ collection, contrast extravasation
Perforation Type	Generally Type III and IV, selected Type II cases	Generally Type I, Type II cases unresponsive to conservative treatment

- Perforation Type: Stapfer classification (Type I: duodenal wall rupture; Type II: periampullary perforation; Type III: bile duct perforation; Type IV: retroperitoneal air)
- Imaging Findings: Pneumoretroperitoneum (PnRP), pneumoperitoneum (PnP), fluid collection (SE) on CT
- Clinical Findings: Abdominal pain, signs of peritonitis, fever, leukocytosis
- Treatment Methods: Conservative treatment, endoscopic clip/oversewing, emergency surgical intervention
- Criteria for Treatment Decision: Hemodynamic instability, generalized peritonitis, high inflammatory response

Analysis plan

- Data were analyzed using SPSS v26.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics (mean, standard deviation, frequency, and percentage) were presented to summarize the data.
- For intergroup comparisons, the Chi-square or Fisher's exact test was used for categorical variables, and the Student's t-test or Mann-Whitney U test was used for continuous variables. A p-value of < 0.05 was considered statistically significant.
- Age, gender, time of diagnosis, perforation type, treatment modality, and outcomes were compared between groups.
- The reasons for conversion to surgery, morbidity and mortality rates, with a particular focus on the high mortality rate in the surgical group (66.6%), were analyzed.

Results

Following a 5-year review, 35 patients, comprising 22 females (62.9%) and 13 males (37.1%), were analyzed for a preliminary diagnosis of post-ERCP perforation. The mean age was 65.97 ± 15.2 years. ERCP was performed for choledocholithiasis in 26 patients, distal common bile duct stenosis in 6, a mass at the head of the pancreas in 2, and hydatid cyst in 1. The mean follow-up period was 12.7 days (Table 2).

CT and clinical features

Patients presented with post-procedural abdominal pain and signs of peritonitis, for which they underwent intravenous contrast-enhanced abdominal imaging within the first 24 hours. Thirteen patients had air, 2 had fluid, and 16 had both air and fluid collections. The tomography scans of 4 patients were negative (Table 2).

Table 2. Demographic, Clinical, and Radiological Characteristics of Patients (n=35)

Feature	Type I (n=7)	Type II (n=19)	Type III (n=4)	Type IV (n=5)	Total (n=35)
Gender (Female/Male)	2/5	15/4	2/2	3/2	22/13
Mean Age (years)	61.4	69.0	56.0	68.8	65.9
ERCP Indication (n)					
Choledocholithiasis	5	14	3	4	26
Distal CBD Stenosis	2	3	1	0	6
Other	0	2	0	1	3
CT Finding (n)					
Air Only	2	7	3	1	13
Fluid Only	0	2	0	0	2
Air + Fluid	5	10	0	1	16
Negative	0	0	1	3	4

Table 3. Treatment Approach and Mortality by Perforation Type

Perforation Type	Conservative Treatment (n=29)	Surgical Treatment (n=6)	Total Mortality Rate (%)
	Number (Mortality)	Number (Mortality)	
Type I (n=7)	5 (1)	2 (1)	28.6
Type II (n=19)	15 (2)	4 (3)	26.3
Type III (n=4)	4 (0)	0 (0)	0
Type IV (n=5)	5 (0)	0 (0)	0

Treatment approach and criteria for conversion to surgery

Six patients (17.1%) who had concordant clinical and imaging findings and developed a systemic inflammatory response underwent surgery. Two of these patients had Type I perforations, and four had Type II perforations. Of the 6 patients who underwent surgical treatment, 4 (66.6%) died in the postoperative period. In the 29 patients for whom a decision for conservative management was made, there were 3 deaths (10.3%) (patients over 80 years of age with at least two comorbidities). The overall success rate in the conservative treatment group was calculated as 89.7%. Treatment outcomes and mortality rates are detailed in Table 3.

Discussion

The requirement for surgery in post-ERCP perforations is a decisive factor for prognosis. The rates of surgical intervention observed in Type I and Type II perforations, along with the accompanying high mortality, demonstrate that these two types require a more aggressive approach in clinical management, which is consistent with the literature. While Type I perforations are generally major duodenal injuries that lead to direct intraperitoneal leakage, Type II cases involve injuries adjacent to the papillary area and present with retroperitoneal air. In our study, a significant portion of Type I and Type II patients required surgical intervention, and the mortality rate in this group was found to be significantly high (3).

In contrast, Type III and IV perforations were observed to have a more limited tissue injury and fewer clinical signs, and thus could be successfully managed with conservative methods. This finding supports the validity of current management algorithms. Particularly, the fact that Type III perforations, being small perforations due to endoscopic sphincterotomy, do not require invasive intervention reinforces the importance of the type classification in the clinical decision-making process.

The literature indicates that Type I perforations are generally associated with full-thickness injury of the duodenal wall and require prompt surgical intervention. In the literature, the rate of surgical decision for Type I perforations appears lower; however, the mortality rate is found to be similar (4). In this study, 2 of the 7 patients who had a Type I perforation underwent surgery, and the mortality rate in this group was 28.5%. Type II perforations involve the periampullary region and are mostly injuries associated with sphincterotomy. In these patients, the indication for surgery increases if the inflammatory response is severe. In our study, 4 of the 19 Type II patients were taken to surgery, and the total mortality of this group was found to be 15.8%. The predominance of Type II perforations as the most common form (54%) in our patient distribution is consistent with the general trend in the literature (5). As this type involves injuries adjacent to the periampullary region, it frequently presents with retroperitoneal air and fluid. Fifteen of our Type II perforation patients were followed in the conservative treatment group, and 14 were

discharged in good health. Our success rate with conservative treatment was 93.3%. According to similar publications, the success rate in patients with Type II perforations was relatively higher (6). In light of these evaluations, the fact that approximately 21% of these patients in our study required surgical intervention shows that conservative treatment can generally be successful in this type, but careful clinical observation is necessary.

In Type I perforations, the rate of surgical requirement is 28.6%, and this group also has the highest mortality rate. This supports the knowledge that this type generally presents with full-thickness duodenal rupture and quickly leads to intraperitoneal contamination. In our study, the prevalence of free air and fluid on CT in this group of patients was significant, and these findings supported the indication for surgery. The literature generally recommends prompt surgery for this group, and our findings confirm this (7).

Type III perforations were seen more rarely (11%), and no patient required surgical intervention. This is due to the fact that these types of perforations are generally small, limited injuries caused by an endoscopic wire or sphincterotomy. The patients were successfully managed conservatively with fluid replacement, antibiotic therapy, and close monitoring (8). In our study as well, the 4 patients with Type III perforation were treated conservatively, and no decision for surgery was made. In this respect, the success rate of conservative treatment in Type III perforations is high and parallels the data in the literature.

Type IV perforations (14%) were also a group that was managed entirely conservatively and had a good prognosis. In these patients, only retroperitoneal air was observed on CT, and there were no significant clinical symptoms or laboratory findings. This shows that Type IV is a form that generally has minimal clinical manifestation and often does not require treatment even if diagnosed. It is primarily attributed to the air administered to maintain lumen patency during the procedure and should not be considered a true perforation (9). The fact that our 5 patients evaluated as Type IV perforation were treated conservatively, did not develop a need for surgery, and had no mortality supports the literature data.

When CT findings are examined, the detection of widespread free air and/or fluid in all cases requiring surgery demonstrates the correlation between imaging and the clinical picture. Furthermore, the average age of patients requiring surgery was found to be higher. This suggests that age may be an indirect determinant of prognosis.

The high mortality rate (66.6%) observed in the surgical treatment group in our study is noteworthy. When the potential factors underlying this situation are examined, it was seen that the patients who went to surgery exhibited more severe clinical findings (widespread peritonitis, sepsis) at the time of diagnosis. In particular, the loss of three of the four patients with Type II perforation for whom a surgical decision was made suggests that the clinical condition at the time the decision for surgery was made was already quite severe and that surgery was performed as a "rescue" procedure. A delay in diagnosis or surgical decision may have led to the depletion of the patient's physiological reserves and a worsening of postoperative outcomes (10). This situation once again highlights the importance of early and aggressive management in patients with suspected perforation (11).

The mean length of hospital stay was found to be significantly longer in patients who underwent surgery (approximately 18.6 days), whereas this period was limited to 6-8 days in conservatively managed patients. This clearly demonstrates the impact of the management method on the use of healthcare resources and patient burden.

Mortality was seen only in the group that underwent surgical intervention and was calculated at a total rate of 8.6%. This rate suggests a poor prognosis that can be associated particularly with late surgery or delayed diagnosis.

CT findings have been an important guide in the clinical decision-making process. The detection of widespread free air and/or intraperitoneal fluid on CT in nearly all patients requiring surgery shows the correlation of imaging findings with clinical severity (12).

Conclusion

Post-ERCP perforation is a rare but serious complication carrying a high risk of morbidity and mortality. Particularly in Type I and II cases requiring surgery, delays in diagnosis and treatment can adversely affect patient prognosis. Therefore, rapid and accurate classification and early decision-making are of vital importance in determining appropriate management for these patients. In Type III and IV cases, successful outcomes are achieved with conservative treatment, making it possible to avoid unnecessary surgical interventions. Consequently, an approach based on the Stapfer classification plays a critical role in patient management.

Ethical approval

The study was approved by İzmir Katip Çelebi University Health Research Ethics Committee (date: 09.10.2025, number: 0597).

Author contribution

The authors confirm contribution to the paper as follows: Study conception and design: MY, FC, OND; data collection: KY, AA, SG; analysis and interpretation of results: MY, ÖG; draft manuscript preparation: MY, FC. All authors reviewed the results and approved the final version of the manuscript.

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Conflict of interest

The authors declare that there is no conflict of interest.

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Research Article

Hyperopia as a risk factor for bilateral non-arteritic anterior ischemic optic neuropathy: a comparative retrospective study

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ABSTRACT

Aim: Non-arteritic anterior ischemic optic neuropathy (NAION) is one of the most common causes of sudden, painless vision loss in individuals over the age of 50 and represents the second most frequent optic neuropathy after glaucoma. Our aim was to retrospectively evaluate refractive errors in individuals diagnosed with unilateral and bilateral NAION and to compare these parameters with those of healthy individuals, thereby elucidating the association between hyperopia, and the disease.

Method: This retrospective study included 52 patients diagnosed with NAION at our neuro-ophthalmology department between January and December 2024. Spherical equivalent (SE) values obtained by autorefractometry were classified as emmetropic (−0.50 to +0.50 D), myopic (< −0.50 D), or hyperopic (≥ +0.50 D). Refractive error distributions and mean SE values were compared among three groups: bilateral NAION (12 patients, 24 eyes), unilateral AION (40 patients, 40 eyes), and healthy controls (40 individuals, 40 eyes).

Results: In the control group, refractive error distribution was 32.5% emmetropic, 22.5% myopic, and 45.0% hyperopic, while in the bilateral NAION group, 66.7% were hyperopic, 25.0% emmetropic, and 8.3% myopic; whereas in the unilateral NAION group, 45.0% were hyperopic, 27.5% emmetropic, and 27.5% myopic. Mean SE values were +1.12 ± 1.44 D (range, −1.12 to +4.00) for the bilateral NAION group, +0.18 ± 1.14 D (range, −2.12 to +3.00) for the unilateral NAION group, and +0.19 ± 0.99 D (range, −2.25 to +1.87) for controls. Differences among groups were statistically significant ($p = 0.003$). Post hoc analysis demonstrated significantly greater hyperopia in the bilateral NAION group compared with both the unilateral NAION and control groups. No significant difference was observed between the unilateral NAION and control groups.

Conclusion: Patients with bilateral NAION demonstrated significantly higher levels of hyperopia compared with those with unilateral NAION and healthy controls. These findings suggest that hyperopia may represent a potential risk marker for bilateral NAION. Careful follow-up of hyperopic patients with unilateral NAION may be warranted to enable early detection and management of contralateral-eye involvement.

Keywords: anterior ischemic optic neuropathy, hyperopia, refractive errors, spherical equivalent

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Introduction

Non-arteritic anterior ischemic optic neuropathy (NAION) is one of the most common causes of sudden, painless vision loss in individuals over the age of 50 and represents the second most frequent optic neuropathy after glaucoma (1). NAION is an acute ischemic event that occurs due to impaired perfusion in the laminar and prelaminar regions of the optic nerve (2). Although NAION is most often unilateral at presentation, it may become bilateral over time, typically developing in the early morning hours and potentially leading to permanent vision loss, thereby constituting a significant clinical problem in ophthalmic practice.

In the pathogenesis of NAION, anatomical factors, in addition to systemic vascular comorbidities such as hypertension and diabetes, are known to play an important role (3,4). In particular, a small optic disc and "crowded disc" configuration are thought to predispose individuals to NAION by affecting the perfusion of nerve fibers (5). This structural predisposition is considered a key factor in the susceptibility to ischemic damage at the level of the optic nerve head. The higher prevalence of this structural narrowing in hyperopic eyes has raised interest in the role of refractive errors in the development of NAION (6).

However, the literature presents conflicting evidence. While some studies have identified hyperopia as a risk factor for NAION (7,8), others have reported no significant differences in spherical equivalent (SE) or axial length measurements between patients and controls (9). This controversy suggests that the association between refractive errors and NAION remains incompletely understood, and these contradictory findings underscore the need for a more detailed investigation of the relationship between refractive errors and NAION.

The aim of the present study is to retrospectively evaluate refractive errors in individuals diagnosed with unilateral and bilateral NAION and to compare these parameters with those of healthy individuals, thereby elucidating the association between hyperopia, and the disease. In addition, by specifically focusing on bilateral cases, the study aims to assess whether a distinct refractive profile may reflect a structural predisposition to more extensive optic nerve involvement.

Methods

This study was conducted using a retrospective case–control design to evaluate refractive parameters in individuals diagnosed with NAION. Data were obtained from the archival records of the Neuro-Ophthalmology Clinic at Beyoğlu Eye Training and Research Hospital. The study was approved by the Ethics Committee of the University of Health Sciences. The study adhered to the principles of the Declaration of Helsinki. Due to the retrospective nature of the study, the requirement for informed consent was waived by the local ethics committee.

A total of 92 participants were included and divided into three groups: bilateral NAION (12 patients, 24 eyes), unilateral NAION (40 patients, 40 eyes), and healthy individuals matched for age and sex as controls (40 individuals, 40 eyes). Inclusion criteria were age 18 years or older and a clinically confirmed diagnosis of NAION. Exclusion criteria comprised arteritic AION, optic neuritis, glaucoma and other optic neuropathies, high refractive errors exceeding ±6.00 D, retinal diseases, previous ocular surgery, and systemic or neurological disorders that could cause visual loss.

Refractive measurements for all participants were obtained using an autorefractometer (KR-800 Auto Kerato-Refractometer, TOPCON, Japan). The spherical equivalent (SE) was calculated by adding half of the cylindrical value to the spherical value (SE = S + C/2), and astigmatism (AST) values were also recorded. Based on SE values, refractive errors were

classified as myopia (SE ≤ −0.50 D), emmetropia (−0.50 D < SE < +0.50 D), and hyperopia (SE ≥ +0.50 D).

Statistical analyses were performed using SPSS software version 22.0 (IBM Corp., Armonk, NY, USA). The Shapiro–Wilk test was used to assess the distribution of data. For normally distributed variables, ANOVA and post hoc Tukey HSD tests were applied, whereas the Kruskal–Wallis and Mann–Whitney U tests were used for non-normally distributed data. Fisher's exact test was employed to compare categorical variables. A p-value of less than 0.05 was considered statistically significant.

Because bilateral NAION is clinically rare, the number of patients in this group was limited. Therefore, data from both eyes of the 12 patients in the bilateral group were analyzed separately (n = 24 eyes). This approach was chosen to increase the amount of data and to allow for the evaluation of refractive characteristics in both eyes of bilateral cases. However, it should be noted that measurements from both eyes of the same individual are not entirely statistically independent, and results should be interpreted with this consideration in mind. Accordingly, this analysis should be regarded as exploratory due to the potential for inter-eye correlation.

Results

Comparison of Age of Patients

The mean age of the control group was 53.76 ± 7.11 years, while the mean ages of the unilateral and bilateral NAION groups were 56.35 ± 9.33 years and 60.08 ± 7.06 years, respectively. No statistically significant difference in age was found among the unilateral NAION, bilateral NAION, and control groups, although the difference approached significance (p = 0.052). According to independent samples t-test results, there was no statistically significant difference in age between the NAION groups (p = 0.151). This finding suggests that refractive parameters could be evaluated with minimal potential confounding by age-related variation.

Refractive Parameters and Distributions According to NAION Groups

The mean spherical equivalent (SE) and astigmatism (AST) values were compared, and refractive classifications were evaluated among the three groups. Participants were divided into unilateral NAION (n = 40), bilateral NAION (n = 12), and healthy control (n = 40) groups (Table 1). The mean SE in the bilateral NAION group was 1.12 ± 1.43 D, which was significantly

Table 1. Refractive Parameters and Distributions According to NAION Groups

Parameter	Bilateral NAION	Unilateral NAION	Control	p value
Number of Eyes (n)	24	40	40	
Mean SE (±SD)	1.12 ± 1.44[a,b]	0.18 ± 1.14	0.19 ± 0.99	0.003
Range [Min-Max]	-1.12 – 4.00	-2.12 – 3.00	-2.25 – 1.87	
Hyperopia (%)	66.7%[c,d]	45.0%	45.0%	0.032
Emmetropia (%)	25.0%	27.5%	32.5%	0.326
Myopia (%)	8.3%	27.5%	22.5%	0.412
Mean AST (±SD)	-0.77 ± 0.47[c]	-0.70 ± 0.45	-0.39 ± 0.42	0.041
Range [Min-Max]	-1.87 – -0.25	-2.00 – 0.00	-1.25 – 0.00	

SE = Spherical Equivalent, AST = Astigmatism. All continuous variables are presented as mean ± standard deviation and range. Values are presented as mean ± standard deviation and range for continuous variables, and as percentages for categorical variables. Comparisons were performed using one-way ANOVA or Kruskal–Wallis test for continuous variables and Fisher's exact test for categorical variables, as appropriate.
a $p < 0.01$ vs control group; b $p < 0.01$ vs unilateral NAION group; c $p < 0.05$ vs control group; d $p < 0.05$ vs unilateral NAION group.

higher than that of both the unilateral NAION group (0.51 ± 1.14 D) and the control group (0.23 ± 1.03 D) (p = 0.003) (Figure 1). Post hoc analyses revealed that this difference was statistically significant between the bilateral and control groups (p = 0.007) and between the bilateral and unilateral groups (p = 0.006). No significant difference was found between the unilateral and control groups in terms of SE (p = 0.999).

According to refractive classification, the prevalence of hyperopia was 66.7% in the bilateral NAION group, 45% in the unilateral NAION group, and 45% in the control group (Table 1). A statistically significant difference in the prevalence of hyperopia was observed between the bilateral group and both the control and unilateral groups (Fisher's exact test: bilateral vs control, p = 0.032; bilateral vs unilateral, p = 0.026). There was no significant difference between the unilateral and control groups.

When astigmatism values were examined, the mean AST was −0.77 ± 0.47 D in the bilateral group and −0.39 ± 0.42 D in the control group (Table 1), and this difference was statistically significant (p = 0.045). The unilateral group (−0.70 ± 0.45) showed similar AST values to the bilateral group, and a significant difference was found compared to the control group (p = 0.049).

Comparison of SE Values Between NAION and Contralateral Eyes

The mean SE values of affected and contralateral eyes in unilateral NAION were 0.182 ± 1.135 D and 0.197 ± 1.251 D, respectively (Figure 2). SE values in NAION eyes showed a normal distribution (p = 0.933), whereas contralateral eyes did not (p = 0.019); however, a paired t-test was used due to the adequate sample size. No significant difference was found between affected and contralateral eyes (p = 0.910), indicating that refractive status may have a limited association with unilateral NAION, at least in terms of spherical equivalent.

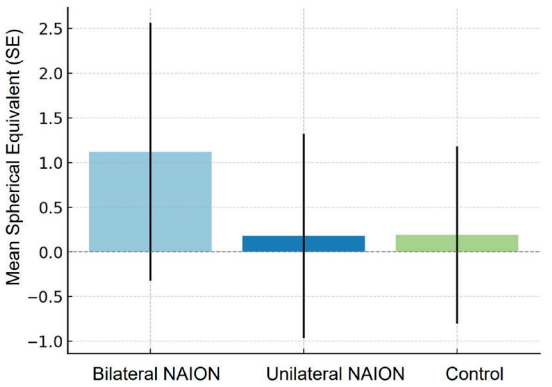

Figure 1. Comparison of mean spherical equivalent (SE, diopters) among bilateral NAION, unilateral NAION, and control groups. Data are presented as mean ± standard deviation (SD). The mean SE was significantly higher in the bilateral NAION group compared with both the unilateral NAION and control groups (p = 0.003).

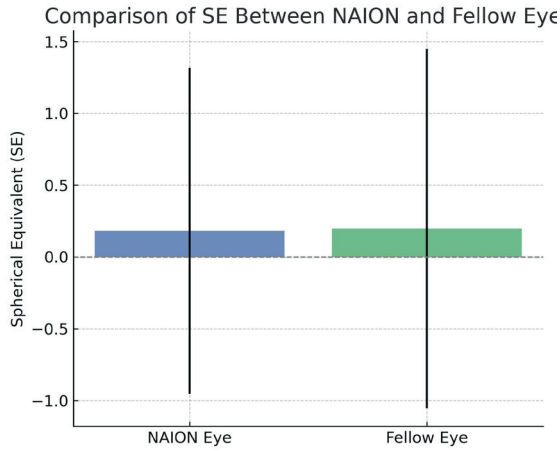

Figure 2. Comparison of spherical equivalent (SE, diopters) between affected NAION eyes and fellow eyes in unilateral NAION patients. Data are presented as mean ± standard deviation (SD). No statistically significant difference was observed between the two eyes (p = 0.910).

Discussion

Hyperopia is typically associated with shorter axial length and smaller overall globe size. This anatomical configuration can result in a narrower scleral canal and a crowded optic disc, creating structural compression at the

level of the optic nerve head and potentially predisposing to perfusion disturbances. As the spherical equivalent shifts toward hyperopia, this configuration may become more susceptible to ischemic events. Although axial length and optic nerve head morphology were not directly measured in our study, these features are generally known to be more prevalent in hyperopic eyes (5,7). Therefore, hyperopia in the present study should be regarded as a surrogate marker of structural predisposition rather than a direct causal factor. This structural predisposition may be more apparent in bilateral NAION cases.

Our findings demonstrate significantly higher SE values and a greater prevalence of hyperopia in the bilateral NAION group compared with the unilateral NAION and control groups. This suggests that hyperopic individuals with structurally small optic discs may have an increased susceptibility to ischemia (6,10). Katz and Spencer reported that the optic nerve head in hyperopic individuals is typically smaller and more crowded, representing a potential risk factor for NAION (7). In contrast, Falavarjani et al. found no direct association between refraction or axial length parameters and NAION development (8). By specifically focusing on bilateral cases, our study highlights that hyperopia is more prominent in this subgroup. However, this association should be interpreted with caution given the retrospective design and the absence of direct structural measurements.

The findings regarding astigmatism are also noteworthy. The bilateral NAION group exhibited higher AST values than the control group, suggesting that not only SE but also corneal shape-related structural factors may have a role in optic nerve perfusion (11,12). However, since a well-established pathophysiological link between astigmatism and NAION does not yet exist, this finding should be considered exploratory. The similarity of refractive parameters between the unilateral NAION and control groups is also striking. This may indicate that vascular risk factors such as hypertension, diabetes, or obstructive sleep apnea play a more dominant role than structural predisposition in unilateral cases (2,13-15). In this context, considering refractive values—particularly in bilateral NAION cases—may aid in early detection, risk assessment, and clinical follow-up. Nevertheless, prospective studies are required to confirm any potential clinical utility.

This study has several limitations. The number of patients in the bilateral NAION group was relatively small, primarily because bilateral NAION is a rare clinical entity, with an incidence reported to be approximately 15–20% in the literature (16-19). The limited number of cases at the study center also affected sample size. Additionally, because both eyes were affected in bilateral NAION patients, data from each eye were analyzed separately. While this approach better reflects clinical reality, it should be interpreted with the understanding that data from both eyes of the same patient are not statistically independent. This consideration is particularly relevant in analyses assuming independence. Future studies with larger sample sizes and multilevel statistical models will be better equipped to address this limitation.

The retrospective design also limits the ability to establish causality. Furthermore, axial length measurements, optic nerve head morphology, and OCT imaging data were not available, preventing direct evaluation of the relationship between hyperopia and structural parameters. Prospective studies with larger cohorts and integrated advanced imaging modalities are needed to expand current knowledge in this area.

Conclusion

This study demonstrated that patients with bilateral non-arteritic anterior ischemic optic neuropathy (NAION) have significantly higher spherical equivalent values and a greater prevalence of hyperopia compared

with unilateral NAION patients and healthy controls. In addition, astigmatism values were significantly higher in bilateral cases. These findings suggest that structural predisposition may play an important role in the development of bilateral NAION. Although anatomical parameters such as axial length and optic disc morphology were not directly measured, features commonly seen in hyperopic eyes—such as smaller globe size and crowded optic discs—may contribute to increased susceptibility to ischemia.

Importantly, hyperopia may represent a potential risk marker for bilateral NAION, indicating that patients with unilateral NAION and hyperopia could benefit from closer clinical follow-up for possible fellow-eye involvement. Identifying such patients may allow clinicians to implement timely preventive measures and individualized follow-up strategies. Considering refractive values, particularly in bilateral NAION cases, may therefore be useful for early detection, risk stratification, and clinical monitoring. Future prospective studies with larger sample sizes and advanced imaging modalities are warranted to further clarify this relationship and to explore preventive strategies for fellow-eye involvement in hyperopic individuals.

Ethical approval

This study was approved by the University of Health Sciences Hamidiye Scientific Research Ethics Committee (date: 27.03.2025, number: 7/14; meeting number: 2025/7)..

Author contribution

The authors confirm contribution to the paper as follows: Study conception and design: ST, MT; data collection: ST, İU, MT; analysis and interpretation of results: ST, İU, MT; draft manuscript preparation: ST, İU. All authors reviewed the results and approved the final version of the manuscript.

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The authors declare the study received no funding.

Conflict of interest

The authors declare that there is no conflict of interest.

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Research Article

Investigation of the wound healing effects of castor oil-based biocompatible greases on the HaCaT cell line

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ABSTRACT

Aim: Castor oil has recently gained attention for its wound-healing properties due to its rich phytochemical composition. In particular, the ricinoleic acid exhibits anti-inflammatory, antibacterial, and skin barrier-supporting effects. In addition, the development of environmentally sustainable and biodegradable materials has increased the interest in plant-based formulations. This study aimed to evaluate the wound healing potential of castor oil-based biocompatible greases at different concentrations using an in vitro scratch assay on human keratinocyte (HaCaT) cells.

Methods: HaCaT cells were cultured in Dulbecco's Modified Eagle Medium (DMEM) supplemented with 10% fetal bovine serum (FBS) and 1% Penicillin–Streptomycin under standard incubation conditions (5% CO_2, 37 °C). Once confluent, a scratch was created in the cell monolayer using a sterile 200 µL pipette tip. Castor oil-based biocompatible greases at different concentrations (0.1%, 1%, 5%, and 10%) were applied to the experimental groups, while standard culture medium served as the negative control. The term "castor oil-based biocompatible grease" refers to castor oil applied at different concentrations in culture medium, representing a component of a proposed grease formulation. Cells were incubated for 0, 12, 24, and 48 hours. Wound closure was evaluated by inverted microscopy and analyzed quantitatively using ImageJ software.

Results: Quantitative analyses demonstrated a concentration-dependent effect of castor oil-based grease on wound closure. The 5% concentration group showed the greatest wound closure rate at 12 hours, comparable to the negative control. Lower concentrations (0.1% and 1%) exhibited slower closure rates, whereas the 10% group showed reduced cell migration and morphological deterioration, suggesting possible cytotoxicity. The order of wound closure effectiveness was 5% castor oil > negative control > Tween control > 10% > 0.1% > 1%.

Conclusion: Castor oil-based biocompatible greases influenced wound healing in a dose-dependent manner, with optimal effects observed at 5% concentration. These findings highlight the potential of castor oil-based greases as biocompatible, biodegradable, and environmentally sustainable biomaterials for wound healing applications, warranting further preclinical and clinical investigations.

Keywords: castor oil, biocompatible grease, wound healing, anti-inflammatory properties

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Introduction

Traditionally, the primary function of grease—similar to mineral oils—is to provide lubrication to machine components by reducing friction and wear. Lubricating greases are particularly preferred in mechanisms that are difficult to access or in systems that remain idle for extended periods (1,2). In these materials, soap molecules are dispersed in oil and organize themselves into a three-dimensional lattice structure, preventing the free flow of oil and allowing the grease to function as a semi-fluid material (3). Greases generally consist of mineral oil, soap thickeners, and additives, with the desired consistency achieved through various combinations of oils, alcohols, and bases (4,5).

A wide variety of such greases are available on the market, including soap-based, non-soap, synthetic, and bio-based types. Modern industrial formulations commonly contain mineral oils combined with metallic soaps, silica, bentonite, or polyurea derivatives (6,7). However, limited petroleum resources and growing environmental concerns have prompted researchers to explore biologically degradable and environmentally friendly alternatives, such as vegetable oils, waste oils, and ionic liquids (8). These formulations typically contain 75–95% base oil, 5–20% thickener, and 0–20% additives, with thickeners most often composed of metallic salts of long-chain fatty acids (9).

Among these alternatives, castor oil-based greases have attracted particular attention due to their biodegradability and environmental sustainability. Gallego et al. developed a castor oil-based grease using chemically modified biopolymer thickeners, and demonstrated properties comparable to those of conventional lithium- and calcium-based greases (10). Castor oil is rich in ricinoleic and linoleic acids, exhibits bactericidal activity, and may support wound healing by maintaining skin moisture balance (11). In addition, as a traditional herbal remedy, castor oil contains various phytochemical compounds, flavonoids, alkaloids, and vitamins, which contribute to its multiple health benefits (12,13).

In recent years, studies have demonstrated the skin-supporting effects of castor oil in wound healing processes. Topical application of castor oil can reduce skin infections and keratosis, alleviate skin problems such as acne, and contribute to wound healing (14). Furthermore, when combined with biocompatible and biodegradable synthetic polymers, castor oil-based greases can serve as potential biomaterials for wound healing patches and drug delivery systems (15-17).

This study aimed to develop an environmentally sustainable, biodegradable, and plant-based castor oil grease formulations and to explore the wound healing potential of these formulations from both biomedical and environmental perspectives.

Methods

The study was performed according to the Helsinki Declaration. Ethical approval for this study was obtained from the Biruni University Scientific Research Ethics Committee (Decision No: 2024-BİAEK/11-07, Date: 30.06.2025). All experimental procedures were conducted after obtaining the relevant ethical approval and in accordance with the principles of the Declaration of Helsinki.

Cell culture preparation

In this study, the human keratinocyte cell line HaCaT was used. The cells were cultured in Dulbecco's Modified Eagle Medium (DMEM) supplemented with 10% Fetal Bovine Serum (FBS) and 1% Penicillin–Streptomycin. The cells were maintained under standard incubation conditions (5% CO_2, 37 °C) and grown in culture flasks until reaching approximately 90% confluency.

Cell culture

Prior to the experiment, cells were cultured at an appropriate suspension prepared at a concentration of 3×10^5 cells/mL and seeded into 6-well culture plates. The plates were incubated for 24–48 hours to allow the cells to reach approximately 90% confluency.

Wound creation (scratch assay)

Once a confluent monolayer was formed, a straight scratch (wound line) was created in the center of the cell layer using a sterile 200 μL pipette tip to initiate the wound healing assay. The wells were then washed with phosphate-buffered saline (PBS) to remove detached cells generated during scratching.

Application of castor oil-based biocompatible grease

Different concentrations (0.1%, 1%, 5%, and 10%) of castor oil-based biocompatible formulations were applied to the experimental groups. The selected concentrations were determined based on preliminary dose-finding experiments conducted to identify non-cytotoxic ranges that did not induce overt cell death or severe morphological alterations. Due to technical limitations, a fully homogeneous grease formulation could not be obtained under in vitro laboratory conditions. Therefore, in the present experimental setup, the term "castor oil-based biocompatible grease" refers to castor oil dispersed in culture medium at the indicated concentrations. The complete grease system, including thickener and additive components, could not be evaluated in this study and remains to be tested in future investigations.

For the negative control group, standard culture medium without any grease was used. In addition to the negative control group, a Tween control group was included to assess the independent effect of the surfactant used as a carrier. Tween 80 (polysorbate 80) was prepared at the same final concentration used to disperse castor oil in the culture medium and was applied to the cells under identical experimental conditions. All experimental groups were performed in triplicate.

Incubation and imaging

Following wound creation, cells were incubated in grease-containing or control media at different time points (0, 12, 24, and 48 hours). At each time point, wound closure was observed under an inverted microscope and digitally imaged.

Wound area analysis

Microscopic images obtained at different time points were analyzed using ImageJ software. The wound closure rate was calculated by measuring the wound area at baseline and at subsequent time intervals. The rate (%) was calculated using the following formula according to the literature (17): Wound closure (%) = $[(A_0 - A_t) / A_0] \times 100$; where A_0 represents the initial wound area and A_t represents the wound area at a specific time point. For comparative analysis, percentage changes relative to the negative control were calculated, where negative values indicate lower wound closure compared to the negative control.

Statistical analysis

The effects of different concentrations of castor oil on wound healing were evaluated in comparison to the control group. Quantitative wound area measurements were evaluated descriptively based on mean values obtained from independent experiments. Given the exploratory nature of the study and the absence of sufficient replicates for formal statistical testing, no inferential statistical comparisons were performed.

Results

In this study, wound healing outcomes reflect the biological effects of castor oil applied at different concentrations in culture medium, as a fully homogeneous grease formulation could not be prepared under the experimental conditions. Scratch assay tests performed on HaCaT cells demonstrated that castor oil-based biocompatible greases at different concentrations produced distinct effects on the wound healing process. Accordingly, negative percentage values reflect impaired wound closure compared to the negative control. Quantitative analyses revealed that at the 12th hour, the lowest wound area percentage was observed in the 5% castor oil group. This group showed a wound closure rate similar to that of the negative control. At lower concentrations (0.1% and 1%), the wound area remained larger, whereas at higher concentration (10%), cell morphology deterioration and reduced cell migration were detected microscopically. In the Tween control group, the wound area was also larger than that of the negative control (Table 1).

These findings indicate that the wound closure rates in descending order were as follows:

5% castor oil > Negative control > Tween control > 10% castor oil > 0.1% castor oil > 1% castor oil.

Microscopic examination revealed that in the 5% castor oil group, cells exhibited intensive migration toward the wound area, re-establishing the monolayer and largely closing the wound gap (Figure 1). In contrast, both low and high concentrations showed weaker cell migration and decreased cell density at the

Table 1. The results of the quantitative analysis, based on wound area measurements

Sample Group	Wound Area (%)	Relative wound closure compared to negative control (%)
Negative Control	24.05	0.0
Tween control	34.32	−42.7
Castor oil 10%	41.69	−73.3
Castor oil 5%	24.53	−2.0
Castor oil 1%	47.95	−99.3
Castor oil 0.1%	44.91	−86.7

Negative values indicate reduced wound closure relative to the negative control group. Data are presented as mean values from independent experiments. Quantitative comparisons are descriptive, and no formal statistical analysis was performed.

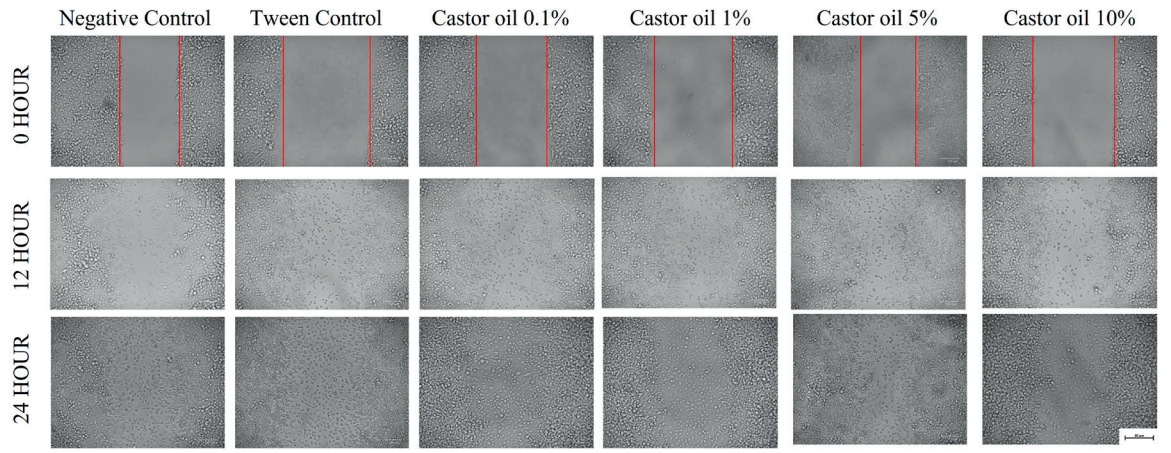

Figure 1. Microscopical Images of Scratch test at 0, 12th and 24th hours of incubations of HaCaT cells from the Negative Control, Tween Control, Castor oil 0.1%, Castor oil 1%, Castor oil 5%, Castor oil 10%

wound edges. The high concentration (10%) was associated with altered cell morphology and reduced migration rates, suggesting a possible cytotoxic or irritant effect.

These data indicate that castor oil-based formulations influence wound healing in HaCaT cells in a dose-dependent manner, with the optimal effect achieved at 5% concentration. The results are consistent with the model described in the Materials and Methods section and confirm the biocompatible, anti-inflammatory, and wound healing potential of this grease formulation.

Discussion

Wound healing is a complex, multi-stage process that requires coordinated cellular and molecular responses. Disruption of this process may delay tissue repair and contribute to the development of chronic wounds, which remains a significant global health problem. Accordingly, there is growing interest in identifying natural and biocompatible materials capable of supporting and accelerating wound repair. In this context, plant-derived oils have attracted considerable attention due to their antioxidant, anti-inflammatory, and regenerative properties (18-20).

In the present study, an in vitro wound healing model using the HaCaT keratinocyte cell line was employed to investigate the effects of different concentrations of castor oil-based formulations on cell migration. Scratch assays results demonstrated a clear dose-dependent response. The 5% castor oil group showed marked cell migration toward the wound area, effective reformation of the epithelial monolayer, and substantial wound closure. In contrast, lower concentrations (0.1% and 1%) resulted in weaker migratory responses, while exposure to a higher concentration (10%) was associated with altered cell morphology and reduced migration rates, suggesting a potential cytotoxic or irritant effect at elevated doses. However, as no dedicated cell viability assays (such as MTT or LDH) were performed, definitive cytotoxicity cannot be concluded and should be interpreted with caution.

These findings can be interpreted in the light of the biological properties of castor oil, which is rich in ricinoleic acid - a fatty acid known for its anti-inflammatory and tissue-regenerative effects (18,19). Consistent with our findings, previous studies have demonstrated that ricinoleic acid attenuates inflammatory processes and supports tissue regeneration, thereby promoting wound repair (18). Similarly, excessive exposure to ricinoleic acid has been reported to exert irritant effects on cell membranes, potentially disrupting membrane permeability and cellular integrity (20), which may explain the impaired migration and morphological deterioration observed at the highest concentration tested in this study. Together, these observations underscore the importance of identifying an optimal concentration range when considering castor oil for wound healing applications.

The inclusion of a Tween-containing control group further highlighted the importance of evaluating carrier substances independently. The relatively low wound closure rate observed in this group suggests that surfactants alone may negatively influence cellular behavior. In line with this observation, Godugu et al. (21) reported that emulsifiers can alter cell membrane permeability and reduce cell viability, emphasizing the need to account for potential confounding effects of formulation components in in vitro wound healing assays.

Our results are in agreement with previous studies investigating plant oil-based materials in wound healing contexts. Lacatusu et al. (16) demonstrated that lipid carriers derived from natural oils support tissue regeneration, while Jaganathan et al. (14) reported enhanced cell proliferation and accelerated wound closure in biomaterials containing castor oil. These studies support the notion that plant-derived oils can positively influence key cellular processes involved in wound repair.

However, an important limitation of the present study is that a fully homogeneous grease formulation could not be prepared under in vitro laboratory conditions. Consequently, the observed biological effects should be attributed solely to castor oil applied at different concentrations in culture medium, and the potential modulatory contributions of other grease components, such as thickeners or additives, could not be assessed. This limitation should be taken into consideration when interpreting the results, particularly with respect to the adverse effects observed at higher concentrations.

Future studies should focus on the development and standardization of fully homogenized grease formulations to enable more comprehensive evaluation of their biocompatibility and wound healing efficacy. Such investigations should include additional assessments of cytotoxicity (e.g., MTT or LDH assays), inflammatory responses, collagen synthesis, and in vivo validation. Similarly, other plant-derived oils, including virgin coconut oil and olive oil, have been reported to enhance wound healing through antioxidant, antibacterial, and pro-regenerative mechanisms (22-24), suggesting shared biological pathways that merit comparative evaluation. Collectively, these findings highlight the potential of natural oil-based formulations as promising, environmentally sustainable candidates for wound healing applications, while emphasizing the need for further systematic investigation.

Conclusion

This study demonstrated that castor oil applied at defined concentrations can influence wound closure and epithelial cell migration in an in vitro HaCaT scratch assay model. The enhanced wound closure observed at the 5% concentration suggests a concentration-dependent effect of castor oil on keratinocyte migration under controlled in vitro conditions. In contrast, the morphological alterations observed at higher concentrations underscore the importance of identifying safe and effective dose ranges.

Given the in vitro nature of this study and the absence of a fully formulated homogeneous grease system, these findings should be interpreted as preliminary. Future studies should focus on the development of standardized formulations and their evaluation using complementary in vitro assays and relevant in vivo models to more comprehensively assess biocompatibility, toxicity, and wound healing efficacy. Overall, the present results provide initial evidence supporting the potential of castor oil-based biomaterials as component of environmentally friendly biomaterial formulations for wound healing applications, warranting further investigation.

Ethical approval

This study was approved by the Biruni University Scientific Research Ethics Committee (Decision No: 2024-BİAEK/11-07, Date: 30.06.2025).

Author contribution

The authors confirm contribution to the paper as follows: Study conception and design: RH, CY, NA; data collection: RH, CY, NA, META, LKB; analysis and interpretation of results: RH, CY, NA, META, LKB; draft manuscript preparation: RH, CY, NA. All authors reviewed the results and approved the final version of the manuscript.

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Conflict of interest

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Research Article

University students' knowledge and attitudes toward rational antibiotic use: implications for public health education

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ABSTRACT

Background: The correct implementation of Rational Drug Use and Rational Antibiotic Use principles is crucial for public health both globally and nationally. The development of effective policies and interventions requires studies evaluating societal perspectives on this issue. Therefore, this study aimed to assess the knowledge, behaviors and attitudes of university students toward the rational antibiotic use, and to contribute to awareness raising when necessary.

Methods: A questionnaire comprising a demographic information form, items on medication use characteristics, and a scale assessing knowledge and attitude toward rational antibiotic use was administered to university students during the 2021-2022 academic year.

Results: A total of 1046 university students participated in the study. Most students reported reading medication instructions (77.1%) and using antibiotics only upon a physician's recommendation (80.0%). Painkillers were the most frequently used medications (47.3%), followed by antibiotics (18.1%). Knowledge scores regarding rational antibiotic use did not differ significantly by gender, class level, economic status or parental education; however, students from the Faculty of Education demonstrated significantly higher knowledge levels ($p<0.05$). In contrast, attitude scores showed significant differences with male students, third-year students, and those with higher income levels exhibiting more positive attitudes toward rational antibiotic use ($p<0.05$). Additionally, students who used antibiotics only with a physician's recommendation and those who avoided using medications prescribed to family members had significantly higher attitude scores ($p<0.001$).

Conclusion: These findings indicate that strengthening rational medication practices among university students requires not only theoretical education but also continuous awareness programs, which may contribute to improved medication use practices within similar academic settings.

Keywords: rational drug use, anti-bacterial agents, health knowledge, attitudes, practice, students, universities, surveys and questionnaires

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Introduction

The correct implementation of Rational Drug Use (RDU) and Rational Antibiotic Use (RAU) principles is essential for effective healthcare delivery and public protection. RDU encompasses appropriate drug selection based on clinical need, correct dosing and duration, cost effectiveness, and adequate patient information, aiming to ensure safe and effective pharmacotherapy (1,2).

Antibiotics play a vital role in the treatment of infectious diseases; however, their inappropriate use remains a major contributor to antimicrobial resistance increased morbidity and mortality rates, and rising healthcare costs (3-5). Antibiotic resistance arises primarily from inappropriate indications, insufficient dosage, inadequate duration, and incorrect administration routes (5-7). Despite global initiatives promoting rational medication practices, inappropriate antibiotic use continues to be widely reported (8-11).

In Türkiye, studies on RDU and RAU have largely focused on healthcare professionals (12-18), while investigations targeting university students remain limited (19-21). This population is particularly important because a substantial proportion of university students are enrolled in health-related programs and will become future healthcare providers. Early identification of their medication use behaviors, knowledge, and attitudes may help inform educational interventions before graduation (9).

Inappropriate antibiotic use is not limited to the physician–patient interaction but reflects broader behavioral and educational factors (22). Therefore, evaluating knowledge and attitudes toward RAU among university students represents an important step toward improving future prescribing behaviors and public awareness.

Accordingly, this study aimed to assess general drug use behaviors and knowledge and attitudes related to RAU among university students at a single university. By addressing this specific population, the findings are expected to contribute to the development of targeted educational strategies and inform future research in similar academic settings.

Material and Methods

This study is a descriptive cross-sectional survey. The study population consists of all students enrolled at Biruni University during the fall semester of the 2021-2022 academic year. According to the Student Affairs Office of our Faculty, there were 3459 students during the planning dates of the study. Using the sample calculation formula below, assuming the prevalence of drug use and antibiotic use knowledge and attitudes is unknown in our population, it was calculated that at least 384 students should be reached with 95% confidence and 5% deviation. Therefore, the goal was to reach at least 384 students. To improve precision and reduce sampling error, we continued recruitment beyond the minimum target and included all eligible and willing students available during data collection, resulting in a larger final sample.

The study was conducted in accordance with the ethical principles of the Helsinki Declaration. Ethical approval was obtained from the Non-Interventional Research Ethics Committee of Biruni University (decision number 2022/69-18, dated 29.04.2022). Written informed consent was obtained from the participating students. This study was conducted in accordance with the Declaration of Helsinki, and all ethical procedures, including informed consent and confidentiality of participant data, were strictly observed.

In this study, students from health-related and non-health-related fields at our university in Istanbul were surveyed. We used stratified sampling based on a known (finite) population frame, with departments as strata, and students were recruited proportionately where feasible. A total of 1046 students participated in the study. Detailed distributions by faculty and

gender are presented in the results and tables. All students, regardless of gender, age, or department, were included in the study.

Data were collected using a demographic information form (9 questions), the "Evaluation of University Students' Drug Use" Survey (17 questions) and the "Knowledge and Attitudes Towards Rational Antibiotic Use" scale (42 questions) developed and validated by Dr. İsmet Çelebi (23). This survey was used to assess students' knowledge and attitudes regarding rational antibiotic use (23). The scale consists of two subscales: a knowledge subscale comprising 12 items and an attitude subscale comprising 16 items, both rated on a five-point Likert scale. Total scores range from 12 to 60 for the knowledge subscale and from 16 to 80 for the attitude subscale, with higher scores indicating better knowledge and more positive attitudes toward rational antibiotic use. In the original validation study, the Cronbach's alpha coefficients were 0.87 for the knowledge subscale and 0.89 for the attitude subscale, indicating high internal consistency. The scale is open-access and was used with appropriate citation.

Statistical analysis

Data were analyzed using SPSS software (IBM SPSS Statistics, version 25.0, IBM Corp., Armonk, NY, USA). Continuous variables were summarized using mean and standard deviation or median and interquartile range, as appropriate, while categorical variables were presented as frequencies and percentages. The normality of continuous variables was assessed using the Shapiro–Wilk test and visual inspection of histograms. For comparisons between two independent groups, the Student's t-test was used for normally distributed variables and the Mann–Whitney U test for non-normally distributed variables. Comparisons among more than two groups were performed using one-way ANOVA or the Kruskal–Wallis test, followed by appropriate post hoc analyses when applicable. Associations between knowledge and attitude scale scores and medication-related behaviors were evaluated using Pearson's correlation coefficient for normally distributed variables and Spearman's rank correlation coefficient otherwise. Effect sizes were calculated using Cohen's d for pairwise comparisons and eta-squared (η^2) for multi-group comparisons. Ninety-five percent confidence intervals were reported where appropriate. A two-tailed p-value <0.05 was considered statistically significant.

Results

A total of 1046 university students participated in the study. The sociodemographic characteristics of the sample are summarized in Table 1. Detailed percentage distributions are presented in the tables and are not repeated in the text. The study population consisted predominantly of female and single students, with participants representing various academic programs and class levels.

Students' medication-related behaviors and antibiotic-use attitudes are presented in Table 2. The most prominent findings included high rates of reading medication instructions and using antibiotics only upon a physician's recommendation. The majority of students reported appropriate medication-related behaviors, including avoiding the use of medications prescribed to others and not experiencing harm due to incorrect medication use. The most prominent findings included high rates of reading medication instructions and using antibiotics only upon a physician's recommendation. The majority of students reported appropriate medication-related behaviors, including avoiding the use of medications prescribed to others and not experiencing harm due to incorrect medication use. Other behavioral details are provided in Table 2.

Comparisons of Rational Use of Antibiotics Knowledge Scale (RUAKS) scores across demographic and behavioral variables are presented in Table 3. No statistically significant

Table 1. Sociodemographic characteristics of the study population (n=1046)

Features		n	%
Gender	Male	266	25.4
	Female	780	74.6
Marital Status	Single	1022	97.7
	Married	24	2.3
Which Program/Department are you studying?	Vocational School	333	31.8
	SABİF	144	13.8
	Faculty of Education	28	2.7
	Faculty of Engineering	80	7.6
	Faculty of Pharmacy	127	12.1
	Faculty of Dentistry	139	13.3
	Faculty of Medicine	195	18.6
Your Class	1st Grade	454	43.4
	2nd Grade	403	38.5
	3rd Grade	154	14.7
	4th Grade	35	3.3
What is your economical situation?	Our income does not cover our expenses	163	15.6
	Our income equals our expenses	571	54.6
	Our income is more than our expenses	312	29.8
What is your mother's educational level?	Illiterate	37	3.5
	Primary education	246	23.5
	Secondary education	438	41.9
	University	263	25.1
	Postgraduate	62	5.9
What is your father's educational level?	Illiterate	18	1.7
	Primary education	183	17.5
	Secondary education	427	40.8
	University	302	28.9
	Postgraduate	116	11.1

Percentages may not total 100 due to rounding.

differences were observed according to gender, class level, economic status, or parental education ($p>0.05$). Knowledge scores differed significantly among academic units, with students from the Faculty of Education demonstrating higher scores compared with other faculties ($p=0.029$). Other observed differences in knowledge scores were not statistically significant and are therefore not emphasized in the text.

Table 4 presents the comparison of Rational Use of Antibiotics Attitude Scale (RUAAS) scores. Several variables showed statistically significant associations with attitude scores. Male students had higher attitude scores than females ($p=0.003$). Attitude scores differed significantly across academic units ($p<0.001$), with the highest scores observed among students from the Faculty of Engineering and SABİF. Class level was also associated with attitudes ($p=0.016$),

Table 2. Evaluation of university students' drug use status and their knowledge levels and attitudes towards rational antibiotic use

Features		n	%
Do you read the instructions for use before using the medicine?	Yes	806	77.1
	No	240	22.9
Do you only use antibiotics when your doctor recommends them?	Yes	837	80.0
	No	209	20.0
Do you use your family members' medications?	Yes	315	30.1
	No	731	69.9
Have you ever suffered any harm due to the wrong use of medication?	Yes	128	12.2
	No	918	87.8
Do you care about the color, smell, packaging and taste of the medicine when using it?	Yes	643	61.5
	No	403	38.5
Do you do research on the drugs to be used?	Yes	750	71.7
	No	296	28.3
Have you used any medication in the last month?	Yes	816	78.2
	No	228	21.8
Did you get your last medication with a prescription?	Yes	596	57.0
	No	449	43.0
Do you use any medications regularly?	Yes	247	23.6
	No	799	76.4
What types of medications have you used?*	Painkiller	660	47.3
	Antibiotic	253	18.1
	Antidepressant	64	4.6
	Muscle relaxant	142	10.2
	Other	276	19.8
How do you use medicine for when you get sick?*	Doctor's referral	908	52.4
	Pharmacist referral	240	13.9
	Family-Environment advice	214	12.4
	Previous experiences	370	21.4
What are the sources of information you get about medicine?*	Doctor	838	29.9
	Pharmacist	585	20.8
	Prospectus	443	15.8
	Internet	603	21.5
	Family-Friends-Environment	337	12.0
Which criteria do you pay attention to when reusing medicine at home?*	Suitability for disease	874	34.9
	Expiration date	851	34.0
	Not exceeding the specified period after opening	546	21.8
	Packaging design	195	7.8
	None of them	39	1.6

*More than one option was marked. Percentages are taken from the respondents.
Percentages may not total 100 due to rounding.

Table 2. Continued

Features		n	%
When do you use medication?*	Cold-flu	781	33.3
	Headache	699	29.8
	Menstruation	301	12.8
	Stomach ache	295	12.6
	Chronic disease	169	7.2
	Before or after sports	31	1.3
	When exams approach	69	2.9
What is your reason for stopping the medication?*	Recovery	837	38.4
	Feeling better	612	28.0
	Forgetting	176	8.1
	Side effects	158	7.2
	Boredom	90	4.1
	Thinking the drug is not effective	159	7.3
	Thinking it is harmful	150	6.9
How do you act if you experience side effects while using the medicine?*	I will see a doctor	854	53.2
	I will stop taking the medication	632	39.4
	I will change the medication	90	5.6
	I will continue taking the medication	30	1.9

*More than one option was marked. Percentages are taken from the respondents.
Percentages may not total 100 due to rounding.

Table 3. Comparison of rational antibiotic knowledge scale mean scores (n=1046)

Features		n	x ± SD	z/x^2	p
Gender	Man	266	65.27±9.48	-0.818	0.413
	Women	780	66.12±8.89		
Which program/department are you studying in?	Vocational School	333	66.59±10.13	14.071	**0.029***
	SABİF	144	66.15±7.65		
	Education Faculty	28	69.14±9.72		
	Engineering Faculty	80	65.51±7.63		
	Pharmacy Faculty	127	66.35±9.14		
	Dentistry Faculty	139	65.53±7.51		
	Medical Faculty	195	64.22±9.25		
Your Class	1st Grade	454	65.62±9.38	3.164	0.367
	2nd Grade	403	66.52±8.86		
	3rd Grade	154	65.01±8.13		
	4th Grade	35	66.34±10.43		
What do you think your economic situation is?	Our income does not cover our expenses.	163	66.93±10.31	4.122	0.127
	Our income is equal to our expenses.	571	65.83±9.01		
	Our income is more than our expenses.	312	65.49±8.41		

* $p < 0.05$ was considered statistically significant. z: Mann–Whitney U test; χ^2: Kruskal–Wallis test.
More than one option could be selected. Percentages are calculated based on the total number of participants and may not sum to 100 due to rounding.

Table 3. Continued

Features		n	x ± SD	z/x²	p
What is your mother's educational level?	Illiterate	37	64.10±8.29	3.649	0.456
	Primary Education	246	65.58±9.43		
	Secondary Education	438	66.49±8.37		
	University	263	65.60±9.81		
	Postgraduate	62	65.33±9.20		
What is your father's educational level?	Illiterate	18	62.61±10.86	5.331	0.255
	Primary Education	183	65.30±8.75		
	Secondary Education	427	66.69±8.89		
	University	302	65.60±9.34		
	Postgraduate	116	65.25±8.90		
Do you have a relative who works in any health field?	Yes	675	65.75±9.19	-1.356	0.174
	No	371	66.20±8.82		
Do you read the instructions before using a medicine?	Yes	806	65.81±8.48	-0.444	0.657
	No	240	66.21±10.82		
Do you use antibiotics only when recommended by a doctor?	Yes	837	65.83±8.93	-0.783	0.434
	No	209	66.20±9.54		
Do you use your family members' medicines?	Yes	315	66.48±9.56	-1.161	0.246
	No	731	65.65±8.82		
Have you ever been harmed by using the wrong medicine?	Yes	128	65.91±8.77	-0.224	0.822
	No	918	65.90±9.09		
Do you care about the color, smell, packaging and taste of the medicine?	Yes	643	66.05±8.67	-0.654	0.513
	No	403	65.65±9.64		
Do you do research on the medicines to be used?	Yes	750	65.82±8.92	-0.658	0.51
	No	296	66.12±9.40		
Have you used any medicine in the last month?	Yes	816	66.15±8.89	-1.324	0.185
	No	228	65.03±9.60		
Did you get the last medicine you used with a prescription?	Yes	596	65.86±8.85	-0.484	0.628
	No	449	65.94±9.33		
Are there any medicines you use regularly?	Yes	247	66.18±8.71	-0.347	0.729
	No	799	65.81±9.17		

* $p < 0.05$ was considered statistically significant. z: Mann–Whitney U test; χ^2: Kruskal–Wallis test.
More than one option could be selected. Percentages are calculated based on the total number of participants and may not sum to 100 due to rounding.

with third-year students exhibiting the highest mean scores. Students whose income exceeded their expenses demonstrated significantly more positive attitudes toward rational antibiotic use (p<0.001).

Regarding medication-related behaviors, students who used antibiotics only upon a doctor's recommendation and those who avoided using medications prescribed to family members had significantly higher attitude scores (p<0.001). Students who had previously experienced harm due to incorrect medication use exhibited significantly lower attitude scores (p=0.011). No other behavioral variables were significantly associated with attitude scores.

Table 4. Comparison of rational antibiotic knowledge scale scores according to selected variables (n=1046)

Features		n	x ± SD	z/x²	p
Gender	Male	266	60.78±11.57	-2.936	**0.003***
	Female	780	62.97±10.72		
Marital Status	Single	1022	62.42±10.96	-0.107	0.915
	Married	24	61.63±12.10		
Which Program/Department are you studying?	Vocational School	333	60.49±9.49	37.908	**<0.001***
	SABİF	144	65.70±9.48		
	Education Faculty	28	64.57±9.15		
	Engineering Faculty	80	65.85±9.73		
	Pharmacy Faculty	127	62.87±10.48		
	Dentistry Faculty	139	62.07±12.17		
	Medicine Faculty	195	61.49±11.89		
Your Class	1st Year	454	61.86±10.72	10.311	**0.016***
	2nd Year	403	62.15±10.83		
	3rd Year	154	64.41±11.84		
	4th Year	35	63.77±11.43		
What is your economic situation?	Our income does not cover our expenses	163	61.19±11.62	14.204	**<0.001***
	Our income is equal to our expenses	571	61.66±11.14		
	Our income is more than our expenses	312	64.42±10.08		
What is your mother's education level?	Illiterate	37	61.32±13.10	5.868	0.209
	Primary Education	246	62.95±10.26		
	Secondary Education	438	62.15±10.56		
	University	263	63.28±11.23		
	Postgraduate	62	59.06±13.50		
What is your father's education level?	Illiterate	18	62.22±11.79	0.760	0.944
	Primary Education	183	62.01±11.23		
	Secondary Education	427	62.92±10.34		
	University	302	62.09±11.45		
	Postgraduate	116	62.05±11.58		
Do you have any relatives who work in the healthcare field?	Yes	675	62.72±11.25	-1.088	0.276
	No	371	61.78±10.69		
Do you read the instructions for use before using the medicine?	Yes	806	62.74±10.54	-1.895	0.058
	No	240	61.33±12.29		
Do you use antibiotics only when recommended by a doctor?	Yes	837	63.45±11.02	-7.020	**<0.001***
	No	209	58.31±9.74		
Do you use your family members' medications?	Yes	315	60.61±10.57	-3.961	**<0.001***
	No	731	63.19±11.07		

* $p < 0.05$ was considered statistically significant. z: Mann–Whitney U test; χ^2: Kruskal–Wallis test.

Table 4. Continued

Features		n	x ± SD	z/x²	p
Have you ever suffered any harm due to the wrong use of medication?	Yes	128	60.22±10.53	-2.541	**0.011***
	No	918	62.72±11.01		
Do you care about the color, smell, packaging and taste of the medicine when using it?	Yes	643	62.45±10.98	-0.220	0.826
	No	403	62.36±11.01		
Do you do research on the drugs to be used?	Yes	750	62.75±10.93	-1.914	0.056
	No	296	61.57±11.08		
Have you used any medication in the last month?	Yes	816	62.38±10.84	-0.318	0.751
	No	228	62.58±11.49		
Did you get your last medication with a prescription?	Yes	596	62.72±11.21	-1.375	0.175
	No	449	62.00±10.68		
Are there any medications that you use regularly?	Yes	247	62.90±10.97	-1.093	0.275
	No	799	62.24±11.02		

* $p < 0.05$ was considered statistically significant. z: Mann–Whitney U test; χ^2: Kruskal–Wallis test.

Discussion

The rational use of medicines and the rational use of antibiotics principles are essential components of effective healthcare and for public health protection. University students represent a critical target group for evaluating these principles, particularly because many will become future healthcare professionals (10). This study provides a comprehensive assessment of drug use behaviors and knowledge and attitudes toward rational antibiotic use among university students from both health-related and non-health-related fields.

One of the main findings of this study is that overall knowledge levels regarding rational antibiotic use showed limited variation across most demographic characteristics. Similar observations have been reported in previous studies, suggesting that demographic factors alone may not be strong determinants of rational drug use knowledge (13,15). However, differences were observed across academic units, indicating that educational context may influence awareness and understanding of rational antibiotic use, as also suggested in earlier literature (18,19).

In contrast to knowledge scores, attitudes toward rational antibiotic use demonstrated greater variability across demographic and behavioral factors. This finding is consistent with previous studies showing that attitudes may be more sensitive to personal experiences and behavioral patterns than knowledge alone (24). Students who adhered to physician recommendations and avoided using medications prescribed to others exhibited more positive attitudes, highlighting the importance of appropriate medication-related behaviors in shaping rational use practices.

Economic status has been reported as an important determinant of access to healthcare and medication use behaviors in the literature (9,25). While some studies have identified associations between income level and rational drug use (24,26), our findings suggest that economic status was not a major determinant of knowledge levels. However, students whose income exceeded their expenses demonstrated more favorable attitudes toward rational antibiotic use, indicating that economic comfort may indirectly influence behavioral orientation rather than knowledge acquisition.

Medication-related behaviors observed in this study align with previous findings indicating that university students frequently rely on physicians and pharmacists as primary information sources (12,15,17,27,28). Nevertheless, non-prescription drug use and early discontinuation of treatment remain important concerns, as reported in earlier studies (29-31). Such behaviors reflect ongoing gaps between awareness and practice and underscore the need for targeted educational interventions focusing on appropriate medication adherence and antibiotic stewardship.

Beyond general medication-related behaviors, several specific patterns observed in this study further illustrate ongoing challenges in rational drug and antibiotic use among university students. In this study, non-prescription drug use remained common among university students, consistent with previous reports (29,31). A substantial proportion of students reported obtaining medications without a physician's prescription or using drugs prescribed to family members, indicating ongoing challenges in rational drug use behaviors. Similar rates of non-prescription drug use have been reported among university students in Türkiye, suggesting that this pattern is persistent despite increased awareness efforts (29,31). Such behaviors may reflect barriers to accessing healthcare services, reliance on previous treatment experiences, and underestimation of potential risks associated with unsupervised medication use.

Regular medication use was reported by a minority of students, and these individuals demonstrated higher knowledge and more favorable attitudes toward rational drug use. While some studies have associated frequent drug use with lower levels of rational use (32), this discrepancy may be explained by differences in study populations and educational exposure. Individuals requiring regular medication, particularly for chronic conditions, may be more engaged with healthcare systems and therefore more knowledgeable about appropriate medication practices. Increased dissemination of public awareness messages in recent years may also have contributed to improved knowledge among this subgroup.

Analgesics and antibiotics were identified as the most commonly used drug groups, in line with national pharmaceutical consumption data and previous studies (30). The widespread use of analgesics is not unexpected given their accessibility and frequent indication for common complaints. However, the continued prominence of antibiotics underscores the importance of reinforcing principles of appropriate antimicrobial use, including correct indication, dosing, and treatment duration, to prevent resistance and related complications (32,33).

Patterns of drug procurement further highlight challenges in rational drug use. A considerable proportion of students reported obtaining medications without prescriptions or recommending drugs to others, behaviors that have been widely documented in both national reports and previous studies (2, 12,13,16,17). Although regulatory measures and awareness campaigns have reduced non-prescription access to antibiotics, some students continue to obtain antibiotics without medical consultation, indicating that irrational antibiotic use persists despite policy interventions.

Physicians and pharmacists were identified as primary sources of medication-related information, consistent with existing literature (12,15,17). Nevertheless, reliance on family members, peers, and prior experience remains evident and may contribute to inappropriate medication practices. These findings emphasize the need for continued educational initiatives that strengthen trust in professional guidance and discourage informal medication sharing (34).

Medication use was most commonly reported for self-limiting conditions such as upper respiratory tract infections and headache, which is consistent with community-based patterns of drug consumption. Premature

discontinuation of treatment upon symptom improvement was also frequently reported, reflecting gaps in understanding treatment completion and adherence, as highlighted in previous studies (33). Although awareness of rational antibiotic use was high, a substantial proportion of students were unable to accurately define the concept, underscoring the need for targeted educational strategies to improve both conceptual understanding and practical application (25).

Another important observation was the association between previous harm due to incorrect drug use and less favorable attitudes toward rational drug use. This finding suggests that negative experiences may influence perceptions and behaviors, emphasizing the importance of preventive education before adverse outcomes occur. Educational strategies aimed at improving rational medication practices may therefore benefit from addressing both knowledge gaps and experiential learning.

The findings of this study should be interpreted in light of several limitations. First, the study was conducted at a single university, which may limit the representativeness of the sample and the generalizability of the results to other student populations in Türkiye. Second, the use of a self-administered questionnaire may have introduced self-report and recall bias, as participants' responses relied on personal reporting rather than objective measures. Third, the cross-sectional design precludes causal inference and limits the ability to assess changes in knowledge, attitudes, or behaviors over time. In addition, although comparisons across demographic and academic subgroups were performed, potential confounding factors were not controlled through multivariable analyses, and therefore observed associations should be interpreted cautiously. Finally, voluntary participation may have introduced selection bias, as students with greater interest in rational drug use may have been more likely to participate.

Conclusion

In conclusion, this study demonstrated that university students generally exhibit appropriate medication-related behaviors; however, gaps persist between knowledge and attitudes toward rational antibiotic use. While knowledge levels showed limited variation across most demographic characteristics, attitudes were more strongly influenced by behavioral factors such as adherence to physician recommendations and avoidance of non-prescription medication use. These findings highlight the importance of integrating targeted educational content and practical awareness initiatives into university curricula, particularly for students in health-related fields. Addressing attitude-related aspects of rational antibiotic use may help strengthen responsible medication practices within similar academic settings.

Ethical approval

Ethical approval was obtained from the Non-Interventional Research Ethics Committee of Biruni University (decision number 2022/69-18, dated 29.04.2022). Written informed consent was obtained from the participating students.

Author contribution

The authors confirm contribution to the paper as follows: Study conception and design: ASD, YEM; data collection: ASD, AOT, EY, EA; analysis and interpretation of results: ASD, BAS, HB, YEM; draft manuscript preparation: ASD, BAS, YEM. All authors reviewed the results and approved the final version of the manuscript.

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Conflict of interest

The authors declare that there is no conflict of interest.

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Case Report

Small bowel obstruction due to spontaneous transomental hernia in an octogenarian patient: a case report

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ABSTRACT

Internal hernia is a condition caused by herniation of intra-abdominal organs through congenital or acquired peritoneal defects and represents a rare cause of small bowel obstruction. Transomental hernia is an uncommon subtype and accounts for a small percentage of all internal hernias, but delayed diagnosis may result in strangulation and increased morbidity, particularly in elderly patients.

We report the successful surgical treatment of small bowel obstruction due to spontaneous transomental hernia in an 86-year-old female patient with no history of previous abdominal surgery. Emergency laparotomy revealed a small bowel loop, approximately 100 cm distal to the ligament of Treitz, herniating through a 1-cm defect in the greater omentum. The herni-ated bowel was viable and was reduced without the need for resection. The postoperative course was uneventful, and the patient was discharged on postoperative day six.

Keywords: hernia, intestinal obstruction, internal hernias, omentum, small bowel obstruction, transomental hernia

Introduction

Internal hernia (IH) is defined as herniation of intra-abdominal organs through congenital or acquired peritoneal defects and represents a rare cause of small bowel obstruction. Transomental hernias (TOH) are an uncommon subgroup of internal hernias and may be associat-ed with significant morbidity and mortality, particularly when diagnosis and surgical inter-vention are delayed (1,2).

Internal hernias are classified as paraduodenal (53%), pericecal (13%), foramen of Winslow (8%), transmesenteric and transmesocolic (8%), intersigmoid (6%), and retroanastomotic (5%), with an overall incidence of approximately 5.8%. Transomental hernias account for only 1–4% of all internal hernias and are often difficult to diagnose preoperatively due to nonspecific clinical findings. Because of their rarity and diagnostic challenges, reporting such cases may contribute to increased clinical awareness and improved management strate-gies (1,3,4).

Case Presentation

An 86-year-old female patient was admitted to the emergency department with a three-day history of nausea, vomiting, and abdominal pain. She had no previous history of similar complaints. Vital signs on admission were stable. Physical examination revealed generalized abdominal tenderness and distension without rebound tenderness or guarding. According to

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the patient's history and information obtained from her relatives, she had no history of previous abdominal surgery.

Abdominal computed tomography (CT) demonstrated dilatation of the small bowel loops proximal to the ileal level, consistent with small bowel obstruction. No specific CT findings suggestive of transomental hernia were identified preoperatively. An incidental hiatal hernia was also noted. The patient was admitted to the general surgery ward with a preliminary di-agnosis of ileus. Due to worsening abdominal pain and deterioration of physical examination findings during follow-up, surgical intervention was decided.

Exploratory laparotomy revealed a 10-cm segment of small bowel, located approximately 100 cm distal to the ligament of Treitz, herniating through a 1-cm defect in the greater omentum (Figure 1).

Figure 1. Intraoperative view demonstrating a dilated small bowel loop herniating through a defect in the greater omentum, with adjacent dilated and collapsed bowel segments.

After reduction of the herniated bowel segment and application of a warm compress, bowel viability was confirmed and no resection was required. The omental defect was eliminated by opening the omentum, thereby preventing re-herniation.

Postoperatively, the patient was started on a liquid diet, followed by a regular diet after passage of flatus on postoperative day four. She was discharged in good condition on postoperative day six. At one-month follow-up, the patient was in good clinical condition and had no complaints.

Discussion

The incidence of internal herniation is approximately 5.8% of intestinal obstruction. Transomental hernia constitutes a small portion of internal hernias, but early diagnosis and treatment are very important because mortality may be high when strangulation develops. Although most transomental hernias occur after surgery, they can also develop spontaneously (4-6).

Transomental herniations account for approximately 1%–4% of all internal herniations, with a reported mortality rate of around 30%, largely due to a higher risk of strangulation compared with other types of internal hernias (1,6). In elderly patients, age-related atrophy of the greater omentum may predispose to spontaneous omental defects even in the absence of prior abdominal surgery (7).

Clinical findings of TOH include abdominal pain, nausea, vomiting, inability to pass gas or stool, and abdominal distension. Although clinical diagnosis is challenging, certain computed tomography findings may be helpful. Contrast-enhanced CT may demonstrate clustering of bowel loops and a beak-like appearance of the incarcerated small bowel loops (8). However, as in our case, these characteristic signs may be absent, making preoperative diagnosis difficult.

Yamaguchi classified transomental hernias into three categories: type A (peritoneal cavity → greater omentum → peritoneal cavity), B (peritoneal cavity → omental bursa → peritoneal cavity), or C (peritoneal cavity → omental bursa)

(7). Our case corresponds to Yamaguchi type A, as the small bowel herniated directly through a defect in the greater omentum and returned to the peritoneal cavity.

TOH can be managed by laparotomy or, in selected cases, laparoscopically. After reduction of the herniated small bowel segment causing obstruction, the decision for bowel resection depends on the presence of ischemic findings. Omental defects may be managed by opening, resection, or ligation of the omentum (9,10). In our case, the omental defect was excised because it was located at the edge of the omentum.

Conclusion

Internal herniation should always be considered in cases of ileus, particularly in patients without a history of abdominal surgery. Although transomental hernia has a lower incidence compared to other types of internal hernias, it carries a high risk of strangulation and should be taken into consideration during surgical decision-making. This case demonstrates that spontaneous transomental hernia can occur in elderly patients and can be successfully managed with timely surgical intervention, even in an octogenarian patient.

Ethical approval

The patient has consented to the submission of the case report for submission to the journal. Patient signed informed consent regarding publishing their data and photographs.

Author contribution

The authors confirm contribution to the paper as follows: Study conception and design: ME; data collection: ME, OŞ; analysis and interpretation of results: ME; draft manuscript preparation: ME, OŞ. All authors reviewed the results and approved the final version of the manuscript.

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Conflict of interest

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