e-ISSN: 3023-6487

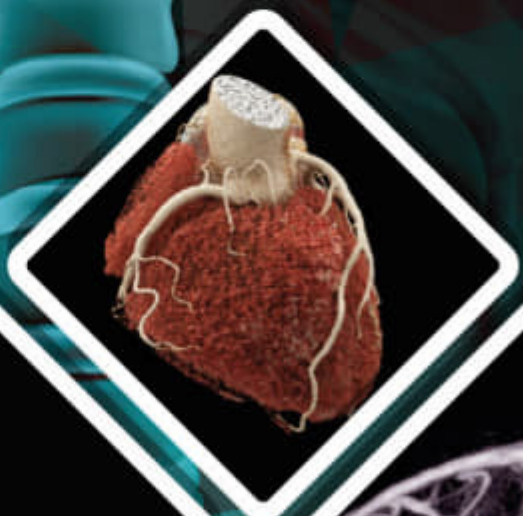
JRM

Journal of Radiology in Medicine

Volume: 2

Issue: 2

Year: 2025



MHA
MEDIHEALTH ACADEMY

EDITORS-IN-CHIEF

EDITORIAL BOARD

ENGLISH LANGUAGE EDITOR

STATISTICS EDITOR

LAYOUT EDITOR

Journal of Radiology in Medicine

Volume: 2 Issue: 2 Year: 2025

Contents

ORIGINAL ARTICLES

CASE REPORTS

Journal of Radiology in Medicine

Original Article

Doi: 10.51271/JRM-0026

Knowledge levels of third- and fourth-year medical faculty students about radiation and radiation dose to which patients are exposed during radiologic imaging

Adnan Özdemir[1], Sıla Akalın[2], Atila Gözen[2], Ceyda Kurşun[2], Merve Sude Keçe[2], Sıla Gökdemir[2]

[1]Department of Radiology, Faculty of Medicine, Kırıkkale University, Kırıkkale, Turkiye
[2]Medical Student, Faculty of Medicine, Kırıkkale University, Kırıkkale, Turkiye

Received: 28.03.2025 ◆ **Accepted**: 17.04.2025 ◆ **Published**: 26.04.2025

Cite this article: Özdemir A, Akalın S, Gözen A, Kurşun C, Keçe MS, Gökdemir S. Knowledge levels of third- and fourth-year medical faculty students about radiation and radiation dose to which patients are exposed during radiologic imaging. *J Radiol Med.* 2025;2(2):23-26.

Corresponding Author: Adnan Özdemir, dradnanozdemir@gmail.com

ABSTRACT

Aims: The aim of this survey study was to determine the level of knowledge of 3rd and 4th year medical students about radiation and radiation dose to which patients are exposed.

Methods: This study is a descriptive and cross-sectional study and was conducted using a questionnaire method (Google Form). The study was conducted between January 2025 and February 2025 among 3rd and 4th year students of Kırıkkale University Faculty of Medicine. In the data collection form used in the study, 3 questions were related to age, gender, and medical school year, while the remaining 22 questions were designed to assess the participants' level of knowledge about radiation and radiation dose to which patients are exposed during radiologic imaging.

Results: A total of 170 students participated in the survey, 101 of whom were 3rd year medical students and 69 of whom were 4th year medical students. When the responses of all students regarding the presence of radiation in radiologic imaging methods were examined, the accuracy rates were found to be: ultrasonography 96.5%; X-ray 95.3%; CT 91.2%; MRI 65.9%; mammography 62.9%; and angiography 51.5%. The 3rd and 4th year students stated that ultrasonography contained 2% and 2.9% radiation, and magnetic resonance imaging contained 30.7% and 30.4% radiation, respectively. Among the questions asked about the effect of radiation, the question "Does radiation exposure cause infertility?" was statistically significant between 3rd and 4th year students ($p<0.005$). No significant difference was found in other questions. It was found that the correct dose estimation was significantly less in the responses of the surveyed students to the dose levels to which the patients were exposed in radiological imaging methods involving ionizing radiation. In addition, a statistically significant difference was found between 3rd and 4th year students in the question of the dose exposure in lower extremity arteriography ($p<0.005$). No significant difference was found in other questions.

Conclusion: Our study and similar studies indicate that the level of knowledge of medical faculty students about radiation and radiation-containing imaging methods is not sufficient. Increasing their level of knowledge on this subject is important for patients to receive correct and adequate treatment. We think that increasing the number of courses on this subject and providing reminder trainings after graduation will be beneficial in terms of enhancing physicians' knowledge.

Keywords: Radiation, harmful effects of radiation, patient safety, knowledge level

INTRODUCTION

Radiation causes adverse biological effects on living organisms. These harmful biological effects are related to the amount of radiation and the duration of exposure.[1,2] Today, some of the imaging methods used in the medical diagnosis and treatment of many diseases contain ionizing radiation. Radiation exposure in diagnostic radiology produces stochastic effects. High-dose ionizing radiation used in treatment has deterministic effects. For certain dose levels in humans, the effects that may occur from blood and chromosome damage to sudden death can be clearly demonstrated, but it is not known what the threshold radiation dose is that will cause cancer or genetic damage in humans.[3] Therefore, it is important to use radiation-containing examinations consciously in medical applications.

Studies have reported that physicians' knowledge about radiation and radiation safety is inadequate.[4,5] Increasing educations about radiation safety and radiation for medical school students will make a significant contribution to reducing radiation exposure.[2,6,7]

In this survey study, we aimed to investigate the level of knowledge of 3rd and 4th year medical school students about radiation and radiation dose to which patients are exposed.

METHODS

This study is a descriptive and cross-sectional study and was conducted using a survey method. The study was conducted between January 2025 and February 2025 among 3rd and 4th year students of Kırıkkale University Faculty of Medicine. Participation in the study was voluntary, and data were collected via Google Form. The study was conducted with the permission of Kırıkkale University Non-interventional Researches Ethics Committee (Date: 15.01.2025, Decision No: 2025.01.02). The study was conducted according to the principles of the Declaration of Helsinki.

The data collection form used in the study consisted of a total of 25 questions. Twenty-two of these questions were designed to assess the participants' level of knowledge about radiation and radiation dose to which patients are exposed during radiologic imaging. The other 3 questions were related to age, gender, and medical school year.

The ionizing radiation doses that patients were exposed to in commonly used radiological imaging methods were asked how many chests radiographs they corresponded to (**Table 1**). Responses were evaluated according to the UNSCEAR 2000 Report, and answers with a deviation of 20% were considered correct. In this report, the doses of countries in radiologic examinations are listed in detail. In the last rows of the tables, the average of the countries was taken. Since dose equivalents were not available for the questions in the questionnaire form for our country, the average values of all countries were taken.[8] The data obtained from the study were entered into the SPSS 25.0 statistical package program, and statistical analyses were evaluated at the $p<0.05$ significance level using chi-square tests with the same program.

Table 1. Dose received by patients when radiological imaging methods are applied (mSv), dose exposure according to chest radiography

Imaging method	Dose (mSv)	Number of corresponding chest radiographs
Barium stomach radiography	3.7	26
Abdominal radiography	0.55	3.92
Abdominal CT	13.3	95
Lower extremity arteriography	12.4	88

mSv: Millisievert, CT: Computed tomography

RESULTS

A total of 170 students participated in the survey, including 101 3rd year medical students and 69 4th year medical students. 58 of the 3rd year students were female and 43 were male, and 47 of the 4th-year students were female and 22 were male.

When the responses of all students regarding the presence of radiation in radiologic imaging methods were examined, the accuracy rates were found as follows: ultrasonography 96.5%; X-ray 95.3%; CT 91.2%; MRI 65.9%; mammography 62.9%; and angiography 51.5% (**Table 2**). When the distribution of 3rd and 4th year students' responses to the same question was analyzed, no statistically significant differences were found between the two years (**Table 3**).

Table 2. Distribution of all students' responses to the question about the presence of radiation in radiologic imaging methods

	Radiation presence					
	Yes		None		I don't know	
Imaging method	**n**	**%**	**n**	**%**	**n**	**%**
X-ray	162	95.3	7	4.1	1	0.6
Ultrasonography	4	2.4	164	96.5	2	1.2
Mammography	107	62.9	39	22.9	24	14.1
Computed tomography	155	91.2	8	5.3	6	3.5
Magnetic resonance imaging	52	30.6	112	65.9	6	3.5
Angiography	87	51.5	42	24.7	41	24.1

Table 3. Distribution of responses to the question about the presence of radiation in radiologic imaging methods

		Radiation presence						
		Yes		None		I don't know		p*
Imaging method	**Year**	**n**	**%**	**n**	**%**	**n**	**%**	
X-ray	3	98	97	2	2	1	1	.172
	4	64	92.8	5	7.2	0	0	
Ultrasonography	3	2	2	97	96	2	2	.468
	4	2	2.9	67	97.1	0	0	
Mammography	3	66	65.3	21	20.8	14	13.9	.690
	4	41	59.4	18	26.1	10	14.5	
Computed tomography	3	89	88.1	7	6.9	5	5	.230
	4	66	95.7	2	2.9	1	1.4	
Magnetic resonance imaging	3	31	30.7	65	64.4	5	5	.469
	4	21	30.4	47	68.1	1	1.4	
Angiography	3	50	49.5	27	26.7	24	23.8	.755
	4	37	53.6	15	21.7	17	24.6	

p* value shows the results of Chi-squared test

Among the questions asked about the effect of radiation, the question "Does radiation exposure cause infertility?" was statistically significant between 3rd and 4th year students. No significant difference was found in other questions (**Table 4**).

It was found that the correct dose estimation was significantly less in the responses of the surveyed students to the dose levels to which patients were exposed in radiological imaging methods involving ionizing radiation (**Table 5**). In addition, a statistically significant difference was found between 3rd and 4th year students in the question of dose exposure in lower extremity arteriography. No significant difference was found in other questions (**Table 5**).

DISCUSSION

Although radiation causes various adverse biological effects in living organisms depending on the dose and exposure

Table 4. Problems related to the effects of radiation questions and distribution of answers

	Year	Yes		None		I don't know		p*
		n	%	n	%	n	%	
Is radiation harmful to living things?	3	100	99	0	0	1	1	.785
	4	68	98.6	0	0	1	1	
Does the effect of radiation depend on the duration of exposure?	3	98	97	2	2	1	1	.892
	4	66	95.7	2	2.9	1	1.4	
Does the effect of radiation depend on the dose of exposure?	3	99	98	0	0	2	2	.796
	4	68	98.2	0	0	1	1	
Does exposure to medical radiation (such as X-rays) cause infertility?	3	65	64.4	8	7.9	28	27.7	.035
	4	43	62.3	14	20.3	12	17.4	
Is there an annual equivalent dose for officials?	3	88	87.1	2	2	11	10.9	.073
	4	67	97.1	0	0	2	2.9	
Do you have sufficient knowledge about ionizing radiation used in medicine and its hazards?	3	41	40.6	30	29.7	30	29.7	.505
	4	32	46.4	22	31.9	15	21.7	
Would you like to have lectures about ionizing radiation used in medicine and the harm of radiation?	3	78	77.2	13	12.9	10	9.9	.920
	4	53	76.8	8	11.6	8	11.6	

p* value shows the results of Chi-squared test

Table 5. Distribution of the respondents' responses to the dose levels to which patients are exposed in radiological imaging methods involving ionizing radiation

		Less		Correct		More		p*
Imaging method	**Year**	**n**	**%**	**n**	**%**	**n**	**%**	
Barium stomach radiography	3	77	76.2	7	6.9	17	16.8	.0838
	4	50	72.5	5	7.2	14	20.3	
Abdominal radiography	3	58	57.4	20	19.8	23	22.8	.314
	4	34	49.3	12	17.4	23	33.3	
Abdominal CT	3	74	73.3	4	4	23	22.8	.149
	4	41	59.4	3	4.3	25	36.2	
Lower extremity arteriography	3	85	84.2	5	5	11	10.9	.003
	4	45	65.2	2	2.9	22	31.9	

CT: Computed tomography, p* value shows the results of Chi-squared test

time, it is indispensable in diagnosis and treatment.[2,9,10] In clinics where medical imaging involving radiation is used, the ALARA (as low as reasonably achievable) principle has been adopted, and it is aimed that the patient and healthcare personnel receive the lowest dose possible.[11]

There is a lack of knowledge about radiological examinations, the effects of radiation, and radiation protection in society. As a result of this lack of knowledge, both patients and healthcare professionals are exposed to excessive radiation doses, unnecessary tests are performed, and this process becomes a social health problem.[12]

Physicians should be familiar with imaging techniques with and without ionizing radiation so that patients are not exposed to unnecessary radiation and can benefit from imaging techniques in the most appropriate way. Arslanoğlu et al.[3] reported that 4% and 27.4% of physicians and interns stated that abdominal ultrasonography and abdominal magnetic resonance imaging methods exposed patients to radiation at a rate of 4% and 27.4%, respectively. According to a study by Jacob et al.[13], 10% and 28% of physicians said that US and MRI contained ionizing radiation, respectively. Shiralkar et al.[14] reported that 5% of physicians said that US and 8% of physicians said that MRI contains ionizing radiation. In our study, similar to the literature, 3rd and 4th year students stated that ultrasonography and magnetic resonance imaging contained 2% and 2.9% and 30.7% and 30.4% radiation, respectively. There was no statistically significant difference between 3rd and 4th year students.

When the imaging modalities containing radiation were analyzed, the accuracy rates of the 3rd and 4th year students were significantly higher. When the answers of all students were evaluated, the presence of radiation was correctly answered by 95.3% in X-ray, 91.2% in CT, 62.9% in mammography, and 51.5% in angiography.

While the answers given to the questions "Does radiation harm living things?", "Does the effect of radiation depend on the duration of exposure?", "Does the effect of radiation depend on the dose of exposure?", and "Is there an annual equivalent dose for officials?" were correct at a high rate, a significant decrease was observed in the correct answer rates given to the question "Does exposure to medical radiation (such as X-rays) cause infertility?" Again, a statistically significant difference was found between the 3rd and 4th year answers to this question.

Unnecessary radiological examinations increase radiation exposure for patients and healthcare professionals. Therefore, increasing education about radiation safety and radiation for

medical faculties and healthcare professionals will make a significant contribution to reducing radiation exposure.[2,6,7] In the study by Çakmak et al.[15], 84.3% of medical students answered yes to the question, "I would like to have courses about ionizing radiation used in medicine and the harms of radiation." In our study, 77.2% and 76.8% of 3rd and 4th year students, respectively, answered yes to a similar question.

In the study by Arslanoğlu et al.[3], 93.1% of physicians and interns answered the questions about the dose received in radiological imaging methods using ionizing radiation as much less radiation dose than it should be. In the Cankorkmaz et al.[16] study, the rates of those who could not estimate the radiation doses correctly were 39.8% for anterior-posterior pelvic radiography, 74.3% for voiding cystourethrography, 71.7% for thoracic computed tomography, and 72.6% for abdominopelvic CT. In our study, students significantly misestimated the radiation doses. The rates of those who could not estimate the radiation dose correctly were 93.1% and 92.8% for barium gastroscopy, 80.2% and 82.6% for abdominal radiography, 96% and 95.7% for abdominal CT, and 95% and 97.1% for lower extremity arteriography in 3rd and 4th year students, respectively. In addition, those who guessed incorrectly tended to underestimate radiation.

CONCLUSION

Our study and similar studies indicate that the level of knowledge of medical faculty students about radiation and radiation-containing imaging methods is not sufficient. Increasing their level of knowledge on this subject is important for patients to receive correct and adequate treatment. We think that increasing the number of courses on this subject and providing reminder trainings after graduation will be beneficial in terms of enhancing physicians' knowledge.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was conducted with the permission of Kırıkkale University Non-interventional Researches Ethics Committee (Date: 15.01.2025, Decision No: 2025.01.02).

Informed Consent

All patients signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Bolus NE. Basic review of radiation biology and terminology. *J Nucl Med Technol*. 2001;29(2):67-77.
2. Brenner DJ, Doll R, Goodhead DT, et al. Cancer risks attributable to low doses of ionizing radiation: assessing what we really know. *Proc Natl Acad Sci USA*. 2003;100(24):13761-13766. doi:10.1073/pnas.2235592100
3. Arslanoğlu A, Bilgin S, Kubalı Z, Ceyhan MN, İlhan MN, Maral I. Radyolojik görüntüleme yöntemleri sırasında hastaların maruz kaldıkları iyonizan radyasyon dozu hakkında doktor ve intern doktorların bilgi düzeyi. *Diagn Interv Radiol*. 2007;*13*:53-55.
4. Güzel A, Temzioöz O, Aksu B, Süt N, Karasalihoğlu S. A cost analysis of radiologic imaging in pediatric trauma patients. *Ulus Travma Acil Cerrahi Derg*. 2010;16(4):313-318.
5. Vural F, Fil Ş, Çiftçi S, Aydın Dura A, Yıldırım F, Patan R. Ameliyathanelerde radyasyon güvenliği; çalışan personelin bilgi, tutum ve davranışları. *Balıkesir Sağlık Bil Derg*. 2012;1(3):131-136.
6. Amare DE, Dagne H. Knowledge and associated factors of medical students regarding radiation exposure from common diagnostic imaging procedures at the University of Gondar, Ethiopia. *Ethiop J Health Sci*. 2020;30(4):589-598. doi:10.4314/ejhs.v30i4.14
7. Teferi S, Zewdeneh D, Bekele S. Pediatric residents' and medical interns' awareness about pediatric Ionizing radiation dose from computed tomography and Its associated risks in tertiary Hospital in Ethiopia. *Ethiop J Health Sci*. 2018;28(4):383-392. doi:10.4314/ejhs.v28i4.4
8. United Nations Scientific Committee on the effects of atomic radiation. www.unscear.org/reports/2000_1. Annex D: Medical radiation exposures. Table 15, Parts A and B; 375–77.
9. Lee CI, Haims AH, Monico EP, Brink JA, Forman HP. Diagnostic CT scans: assessment of patient, physician, and radiologist awareness of radiation dose and possible risks. *Radiology*. 2004;231(2):393-398. doi:10.1148/radiol.2312030767
10. Hauptmann M, Mohan AK, Doody MM, Linet MS, Mabuchi K. Mortality from diseases of the circulatory system in radiologic technologists in the United States. *Am J Epidemiol*. 2003;157(3):239-248. doi:10.1093/aje/kwf189
11. Lurie AG. Doses, benefits, safety, and risks in oral and maxillofacial diagnostic imaging. *Health Phys*. 2019;116(2):163-169. doi:10.1097/HP.0000000000001030
12. Özdemir A, Atlı VR, Alıcı C, et al. Knowledge level of the community about radiological examinations and harmful effects of radiation:a review. *J Radiol Med*. 2024;1(2):27-30. doi:10.51271/JRM-0008
13. Jacob K, Vivian G, Steel JR. X-ray dose training: are we exposed to enough? *Clin Radiol*. 2004;59(10):928-927. doi:10.1016/j.crad.2004.04.020
14. Shiralkar S, Rennie A, Snow M, Galland RB, Lewis MH, Gower-Thomas K. Doctors' knowledge of radiation exposure: questionnaire study. *BMJ*. 2003;327(7411):371-372. doi:10.1136/bmj.327.7411.371
15. Çakmak V, Akış Ç, Koç M, Güngör B, Tuncel D. Pamukkale Üniversitesi Tıp Fakültesi öğrencilerinin tıbbi radyasyon ve radyasyon güvenliği hakkında bilgi düzeyleri. *Pamukkale Medical Journal*. 2022;*15*(3):461-466. doi:10.31362/patd.997289
16. Cankorkmaz L, Özşahin S, Gümüş C, Arslan M, Köylüoğlu G. Radyolojik görüntüleme yöntemlerinde hastaların maruz kaldığı iyonizan radyasyon dozu hakkında sınıf IV tıp öğrencilerinin bilgi düzeyi. *Cumhuriyet Medical Journal*. 2009;31(3):226-230.

Journal of Radiology Medicine in

Original Article

Doi: 10.51271/JRM-0027

Retrospective evaluation of coccygeal fractures: clinical features and radiological findings from a single-centre study

İhsaniye Süer Doğan[1], Nezih Kavak[2]

[1]Department of Radiology, Ankara Etlik City Hospital, Ankara, Turkiye
[2]Department of Emergency Medicine, Ankara Etlik City Hospital, Ankara, Turkiye

Received: 01.04.2025 ◆ **Accepted**: 17.04.2025 ◆ **Published**: 26.04.2025

Cite this article: Süer Doğan İ, Kavak N. Retrospective evaluation of coccygeal fractures: clinical features and radiological findings from a single-centre study. *J Radiol Med*. 2025;2(2):27-31.

Corresponding Author: İhsaniye Süer Doğan, dr.ihsaniye@gmail.com

ABSTRACT

Aims: This study aims to evaluate the demographic, epidemiological, and radiological characteristics of patients diagnosed with coccyx fractures in the emergency department.

Methods: Patients who presented between October 2022 and January 2025 and were diagnosed with coccygeal fractures in the emergency department were retrospectively evaluated. Patient variables analysed included age, sex, season of presentation, mechanism of trauma, type(s) of radiological investigations performed, and the presence of any accompanying injuries.

Results: 105 patients were included in the study, the mean patient age was 46.00±18.45 years (range: 18–82 years). Of the patients, 41.9% were female and 58.1% were male. The highest incidence of presentation occurred during the winter season, accounting for 50.5% (n=53) of cases. The most prevalent trauma mechanism was ground-level falls, observed in 51.4% (n=54) of patients. Direct radiography was performed in 55.2% (n=58) of cases. The most common associated injury was pelvic or sacral trauma, noted in 52.6% (n=10) of patients with concomitant injuries. No statistically significant differences were identified between male and female patients regarding age, trauma mechanisms, or the presence of accompanying injuries ($p>0.05$ for all comparisons).

Conclusion: Coccygeal fractures, while frequently underestimated, can significantly impair quality of life and are more prevalent in females and during the winter months. Ground-level falls were the most common cause, and although often isolated, some cases were associated with pelvic or sacral injuries.

Keywords: Coccyx fracture, trauma, emergency department

INTRODUCTION

The coccyx, or tailbone, is a small triangular bone located at the distal end of the vertebral column, typically composed of three to five fused vertebrae, with its proximal segment articulating with the sacrum.[1] Its name is derived from its resemblance to a cuckoo bird's beak.[2] Although often considered vestigial, the coccyx serves a significant anatomical role as part of the pelvic tripod, alongside the ischial bones, and functions as a critical attachment site for numerous ligaments and muscles of the pelvic floor.[3] It bears weight in the seated position and contributes to postural support.

The true incidence of coccygeal fractures remains unclear, largely due to underreporting and diagnostic challenges.[4] Such fractures may result from various mechanisms, most commonly low-energy trauma such as ground-level falls, or obstetric events like childbirth. Trauma-induced coccygeal pain, clinically referred to as coccydynia, can significantly impair quality of life, particularly when sitting.

Diagnosis of coccyx fractures typically requires a combination of clinical examination and imaging modalities.

This study aimed to assess the demographic, epidemiological, and radiological characteristics of patients diagnosed with coccygeal fractures in the emergency department (ED).

METHODS

Ethics

This retrospective study was approved by the Ankara Etlik City Hospital Evaluation of Scientific Researches and Ethics Committee (Date: 26.02.2025, Decision No: 2025-0241). All

procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Study Design and Subjects

Patients who presented between October 2022 and January 2025 and were diagnosed with coccygeal fractures were retrospectively evaluated.

Inclusion criteria comprised individuals aged 18 years or older who were diagnosed with a coccyx fracture upon presentation to the ED. Exclusion criteria included a prior history of coccygeal or sacral injury, presence of infectious processes or space-occupying lesions in the sacrococcygeal region, and absence of radiological imaging.

Patient variables analysed included age, sex, season of presentation, mechanism of trauma, type(s) of radiological investigations performed, and the presence of any accompanying injuries.

Statistical Analysis

Descriptive statistics for continuous variables were expressed as mean±standard deviation, median, minimum, and maximum values, while categorical variables were summarised as counts and percentages. The Mann–Whitney U test was employed for comparing age between male and female patients. For categorical comparisons between sexes, Chi-square or Fisher's exact tests were used where appropriate. All analyses were conducted using IBM SPSS Statistics for Windows, version 20.0 (IBM Corp., Armonk, NY, USA). A p-value of less than 0.05 was considered statistically significant.

RESULTS

105 patients were included in the study, The mean age was 46.00±18.45 years, with patient ages ranging from 18 to 82 years. Of the cohort, 41.9% were female and 58.1% were male. The majority of presentations (50.5%, n=53) occurred during the winter season. The most frequently reported trauma mechanism was ground-level falls, observed in 51.4% (n=54) of cases.

Direct radiography was performed in 55.2% (n=58) of patients. Imaging modalities varied across the cohort: 30.5% (n=32) of patients underwent direct radiography alone, 24.8% (n=26) underwent both direct radiography and computed tomography (CT), and 35.2% (n=37) underwent CT alone. The most commonly observed concomitant injury was pelvic or sacral trauma, reported in 52.6% (n=10) of those with associated injuries (**Table 1, Figure 1a, b, Figure 2a, b, c, d, e, Figure 3a, b, Figure 4a, b**).

A statistically significant difference was observed between the ages of female and male patients (p<0.001) (**Table 2**).

No statistically significant differences were found between female and male patients in terms of trauma mechanisms or the presence of associated injuries (p>0.05) (**Table 3**).

DISCUSSION

Coccygeal fractures, although often underestimated, are clinically important due to their impact on daily functioning and the difficulties they pose in diagnosis and treatment. Such fractures may result in coccydynia, a painful condition

Table 1. Distribution of patients by age, sex, radiological evaluation, and associated injuries

	Mean±SD median (min–max)	
Age (years)	46.00±18.45 43 (18-82)	
	n	**%**
Sex		
Female	44	41.9
Male	61	58.1
Season of patient presentation		
Winter	53	50.5
Summer	14	13.3
Autumn	27	25.7
Spring	11	10.5
Mechanism of trauma		
Fall from height	17	16.2
Ground-level fall	54	51.4
Motor vehicle accident	15	14.3
Assault	7	6.7
Fall from animal riding	2	1.9
Bicycle/motorcycle fall	10	9.5
Absent	47	44.8
Present	58	55.2
Direct radiography performed		
Absent	47	44.8
Present	58	55.2
Computed tomography performed		
Absent	42	40.0
Present	63	60.0
Associated injuries		
Absent	86	81.9
Present	19	18.1
Location of associated injury (n=19)		
Pelvis/sacrum	10	52.6
Traumatic brain injury	2	10.5
Vertebral fractures	4	21.1
Rib fractures	2	10.5
Radius fracture	1	5.3

SD: Standard deviation, Min: Minimum, Max: Maximum

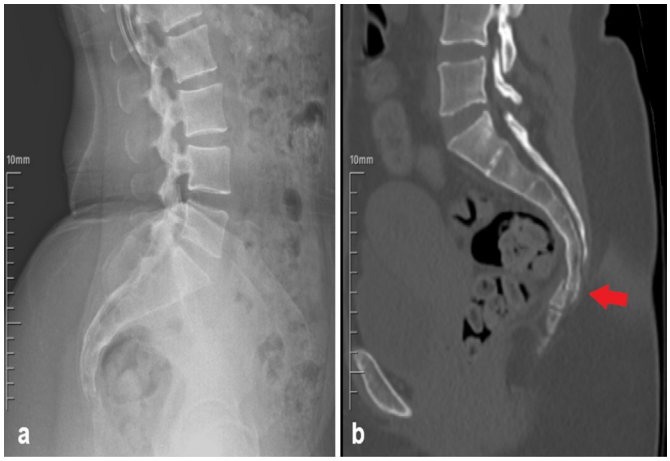


Figure 1a, b. X-ray lateral view, oblique radiolucency in the second coccygeal segment suggestive of a fracture (**a**), Sagittal bone window reformat computed tomogrphy, fracture of the second coccygeal segment, with minimally displaced fragments (red arrow) (**b**).

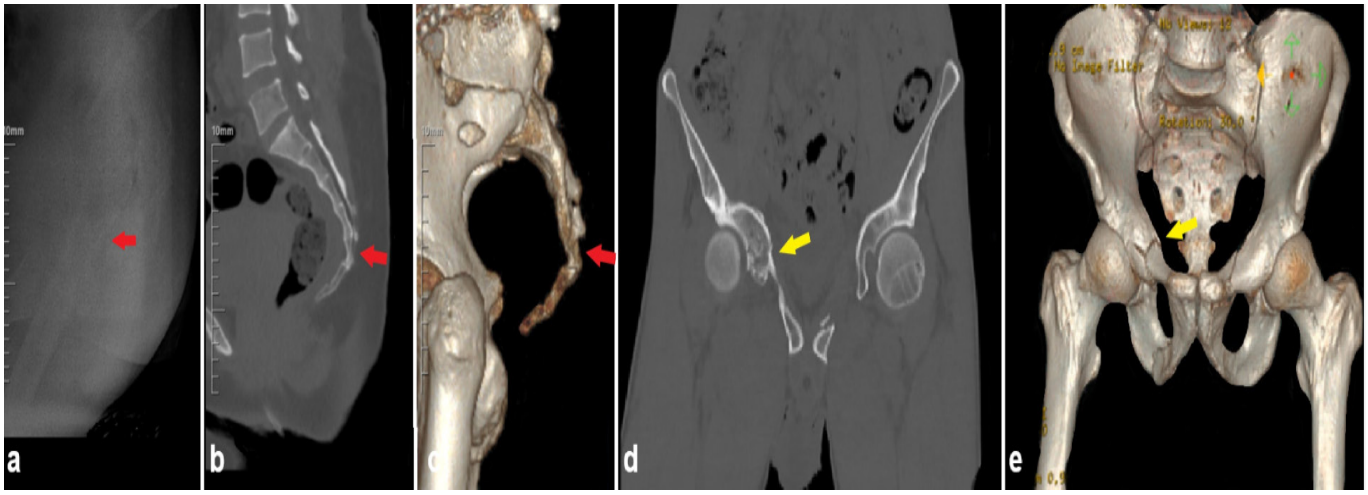


Figure 2a, b, c, d, e. X-ray lateral view oblique radiolucency in the first coccygeal segment suggestive of a fracture (red arrow) (**a**), sagittal bone window reformat computed tomography fracture of first coccygeal segment (red arrow) (**b**), 3-dimensional computed tomography fracture of first coccygeal segment (red arrow) (**c**), coronal bone window reformat computed tomography right acetabulum segmented non-displaced fracture (yellow arrow) (**d**), 3-dimensional computed tomography right acetabulum segmented non-displaced fracture (yellow arrow) (**e**).

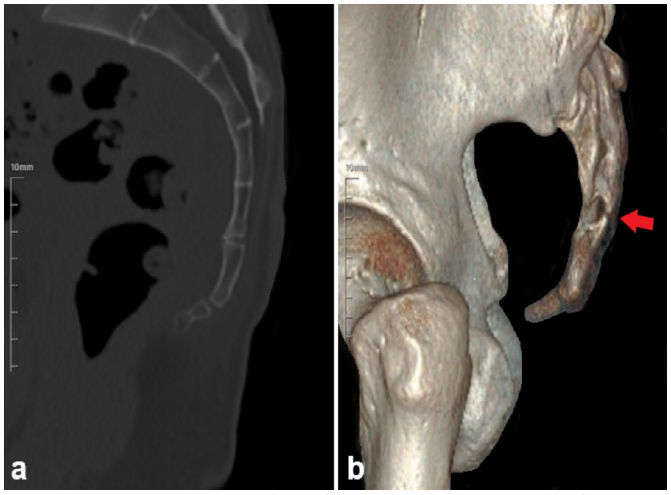


Figure 3a, b. Sagittal bone window reformatcomputed tomography fracture of first coccygeal segment (**a**), 3-dimensional computed tomography fracture of first coccygealsegment (red arrow) (**b**)

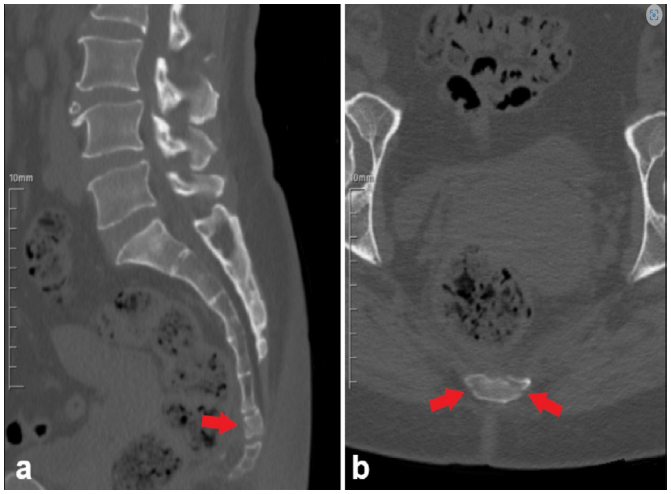


Figure 4a, b. Sagittal bone window reformat computed tomography fracture of first coccygeal segment (red arrow) (**a**), axial bone window computed tomography fracture of first coccygeal segment (red arrow) (**b**)

Table 2. Comparison of age between female and male patients

	Female	Male	p
	Mean±SD median (min-max)	Mean±SD median (min-max)	
Age (years)	50.18±21.10 53 (18-82)	43.00±15.79 41 (18-77)	0.001

Mann-Whitney U test, SD: Standard deviation, Min: Minimum, Max: Maximum

Table 3. Comparison of trauma mechanisms and associated injuries between female and male patients

	Female		Male		p
	n	%	n	%	
Trauma mechanism					
Fall from height	5	11.4	12	19.7	0.314
Ground-level fall	27	61.4	27	44.3	
Motor vehicle accident	7	15.9	8	13.1	
Assault	1	2.3	6	9.8	
Fall from animal riding	0	0	2	3.3	
Bicycle/motorcycle fall	4	9.1	6	9.8	
Associated injuries					
Absent	38	86.4	48	78.7	0.313
Present	6	13.6	13	21.3	

Chi-square test/Fisher's exact test

localised to the coccyx, that can markedly impair functional capacity, particularly during prolonged sitting. Maigne et al.[5] reported that traumatic events occurring within one month prior to symptom onset substantially increase the likelihood of developing coccydynia. This study examined the demographic, epidemiological, and radiological characteristics of patients diagnosed with coccygeal fractures in the ED setting.

A population-based study conducted in South Korea identified 238.906 cases of coccyx fractures between 2010 and 2018, reporting a higher incidence in females, with a female-to-male ratio of 2.6:1. The highest frequency occurred during puberty in males (ages 10–14) and during the menopausal period in females (ages 50–54).[6] Decreased bone mineral density due to osteoporosis significantly increases the risk of coccygeal fractures in older adults by making bones more susceptible to low-energy trauma. The elevated incidence of such fractures among postmenopausal women reflects the combined effects of ageing and hormonal changes on skeletal health.[6] Consistent with previous findings, the present study also demonstrated a higher frequency of coccygeal fractures in females at older ages compared to males. Promoting regular physical activity

and encouraging a balanced diet rich in calcium and vitamin D may contribute to maintaining bone health and reducing the risk of osteoporosis-related fractures.[7]

Risk factors for coccygeal fractures include childbirth, particularly in cases involving difficult or instrument-assisted deliveries, as well as falls on slippery surfaces.[8,9] The incidence of these fractures has been shown to inversely correlate with ambient temperature, with a higher prevalence during the winter months.[6] In the present study, coccygeal fractures were also observed more frequently during winter. Enhancing public awareness of ice-related hazards and promoting safe practices, such as the use of appropriate footwear and walking aids, may help reduce fracture incidence. Furthermore, coccygeal fractures were also recorded in other seasons, particularly autumn. This may be attributable to rain-induced slippery surfaces during autumn, as well as other mechanisms such as motor vehicle accidents and high-impact falls occurring in different months.

Coccygeal fractures can be challenging to diagnose due to their often subtle presentation on radiographic imaging. Early identification and individualised management are essential for improving clinical outcomes, particularly in cases involving concomitant injuries or comorbid conditions. While conventional radiography remains a standard initial diagnostic tool, its sensitivity is limited, especially for minimally displaced or occult fractures. Standard sacrococcygeal radiographs demonstrate low diagnostic yield; one study reported a positivity rate of only 8.4% among 687 patients.[9]

CT is considered the gold standard for the initial evaluation of coccyx fractures, owing to its superior ability to delineate fracture morphology, guide decisions regarding surgical intervention, and provide rapid assessment in emergency settings.[10,11] The selection of imaging modality may also depend on institutional availability and the specific clinical context. In the present study, direct radiography and CT were employed as standalone diagnostic modalities at nearly equal frequencies.

Coccygeal fractures may coexist with pelvic injuries, particularly in the context of high-energy trauma. The concurrence of pelvic-acetabular and coccygeal fractures is frequently observed in patients presenting with severe polytrauma.[12] Sacral fractures, which are commonly linked to pelvic ring disruptions, may also accompany coccygeal fractures. Although coccygeal fractures typically present as isolated injuries, they have been reported in vertical shear trauma patterns involving the pelvic ring.[13,14] Moreover, one study identified coccygeal fractures in 34.62% of patients with spinal cord injuries who presented with pain localised to the lower back, hip, gluteal region, or thigh.[15] In instances of high-energy trauma, anterior displacement of the coccyx may be associated with complications such as cerebrospinal fluid leakage and bladder dysfunction.[16,17]

Although conservative management remains the standard approach for most coccygeal fractures, treatment strategies should be individualised based on the intensity of symptoms, the presence of complications, and patient-specific considerations.

Limitations

This study has several limitations. First, its single-centre design may restrict the generalisability of the findings to broader populations. Although dynamic X-ray imaging is valuable for assessing coccygeal hypermobility and dislocation, standard radiographs in this study were not obtained dynamically, which constitutes a major methodological limitation. Furthermore, long-term follow-up data on clinical outcomes were not available, precluding evaluation of symptom progression or treatment efficacy.

Future multi-centre studies incorporating dynamic imaging protocols and longitudinal patient monitoring are warranted to enhance diagnostic accuracy and to better understand the long-term consequences and management outcomes of coccygeal fractures.

CONCLUSION

Coccygeal fractures, while frequently underestimated, can significantly impair quality of life and are more prevalent in females and during the winter months. Ground-level falls were the most common cause, and although often isolated, some cases were associated with pelvic or sacral injuries. CT demonstrated superior diagnostic value compared to conventional radiography. These findings contribute to the limited national data and underscore the importance of preventive strategies, particularly in older adults and during high-risk seasons.

ETHICAL DECLARATIONS

Ethics Committee Approval

Approved by the Ankara Etlik City Hospital Evaluation of Scientific Researches and Ethics Committee (Date: 26.02.2025, Decision No: 2025-0241).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version

REFERENCES

1. Mostafa E, Varacallo MA. Anatomy, Back, Coccygeal Vertebrae. 2023 Jun 5. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan–. PMID: 31751060.
2. Tetiker H, Koşar MI, Çullu N, et al. MRI-based detailed evaluation of the anatomy of the human coccyx among Turkish adults. *Niger J Clin Pract*. 2017;20(2):136-142. doi:10.4103/1119-3077.198313
3. Lirette LS, Chaiban G, Tolba R, Eissa H. Coccydynia: an overview of the anatomy, etiology, and treatment of coccyx pain. *Ochsner J.* 2014;14(1): 84-87.
4. Guneri B, Gungor G. Morphological features of the coccyx in the Turkish population and interrelationships among the parameters: a computerized tomography-based analysis. *Cureus.* 2021;13(11):e19687. doi:10.7759/cureus.19687

5. Maigne JY, Doursounian L, Chatellier G. Causes and mechanisms of common coccydynia: role of body mass index and coccygeal trauma. *Spine (Phila Pa 1976).* 2000;25(23):3072-3079. doi:10.1097/00007632-200012010-00015
6. Won H, Moon SY, Park JH, et al. Epidemiology and risk factors of coccyx fracture: a study using national claim database in South Korea. *Injury.* 2020;51(10):2278-2282. doi:10.1016/j.injury.2020.07.019
7. Zhou PA, Zhang H, Nie Y, Zhang Y, Wang Y. Advances in the research field of osteoporosis in cold areas. *Frigid Zone Medicine*, 2022;2(1):1-9. doi:10.2478/fzm-2022-0001
8. Alhubaishi L, Flayyih R, Adan H, et al. Intrapartum coccygeal fracture in a young female: a case of prolonged postpartum coccygodynia. *Cureus*. 2025;17(1):e77233. doi:10.7759/cureus.77233
9. Hanna TN, Sadiq M, Ditkofsky N, et al. Sacrum and coccyx radiographs have limited clinical impact in the emergency department. *AJR Am J Roentgenol*. 2016;206(4):681-686. doi:10.2214/AJR.15.15095
10. Almansouri DH, Elsherbini AI, Alharthi M, ALotaibi S, Alshehri L. The role of MRI and CT scan in classification and management of pelvic fractures: a systematic review. *Cureus*. 2024;16(1):e52215. doi:10.7759/cureus.52215
11. Rahman R, Yagi N, Hayashi K, Maruo A, Muratsu H, Kobashi S. Enhancing fracture diagnosis in pelvic X-rays by deep convolutional neural network with synthesized images from 3D-CT. *Sci Rep.* 2024;14(1):8004. doi:10.1038/s41598-024-58810-4
12. Fiolin J, Pontoh LAP, Dilogo IH. Management of complex pelvic fracture with associated both column acetabular fracture judet-letournel type and a coccygeal fracture in a severe polytrauma patient. *Case Rep Orthop Res*. 2021;4(2):192-201. doi:10.1159/000515563
13. Beckmann N, Cai C. CT characteristics of traumatic sacral fractures in association with pelvic ring injuries: correlation using the Young-Burgess classification system. *Emerg Radiol*. 2017;24(3):255-262. doi:10.1007/s10140-016-1476-0
14. Park YS, Baek SW, Kim HS, Park KC. Management of sacral fractures associated with spinal or pelvic ring injury. *J Trauma Acute Care Surg.* 2012;73(1):239-242. doi:10.1097/TA.0b013e31825a79d2
15. Tekin L, Yilmaz B, Alaca R, Ozçakar L, Dinçer K. Coccyx fractures in patients with spinal cord injury. *Eur J Phys Rehabil Med.* 2010;46(1):43-46.
16. Cawley DT, Power F, Murphy M. Cerebrospinal fluid leak after coccyx fracture. *Spine J.* 2016;16(11):e735-e736. doi:10.1016/j.spinee.2016.03.055
17. Foye PM, Singh R, Tangri V. Cerebrospinal fluid leak after fracture of the sacrum or coccyx. *Spine J.* 2019;19(12):2044. doi:10.1016/j.spinee.2019.07.018

Journal of Radiology Medicine in

Original Article

Doi: 10.51271/JRM-0028

YouTube™ videos as a source of information about thyroid ablation treatments for medical students

Pelin Zeynep Bekin Sarıkaya[1], Ceylin Cumur[2], Elif Nur Ekşi[2], İrem Ayaz[2], Server Nur Damla Koç[2]

[1]Department of Radiology, Faculty of Medicine, Kırıkkale University, Kırıkkale, Turkiye
[2]Undergraduate Student, Faculty of Medicine, Kırıkkale University, Kırıkkale, Turkiye

Received: 20.03.2025 ◆ **Accepted**: 25.04.2025 ◆ **Published**: 26.04.2025

Cite this article: Bekin Sarıkaya PZ, Cumur C, Ekşi EN, Ayaz İ, Koç SND. YouTube™ videos as a source of information about thyroid ablation treatments for medical students. *J Radiol Med.* 2025;2(2):32-35.

Corresponding Author: Pelin Zeynep Bekin Sarıkaya, zeybekin@hotmail.com

ABSTRACT

Aims: The aim of our study was to evaluate the content about thyroid ablation on YouTube™ in terms of scientific accuracy, usefulness, and quality of information for patients and healthcare professionals.

Methods: Within the scope of the study, videos on YouTube™ were evaluated by medical students who did not have detailed information about thyroid ablation treatments. After searching YouTube™ with the relevant keywords, 43 videos were evaluated. After the videos were excluded according to our criteria, the remaining 30 videos were analyzed and scored on DISCERN and Global Quality Scale scores. According to DISCERN scores, low-quality videos with useless content below 50 points were grouped as group 1, and videos with useful content above 50 points were grouped as group 2. General information (number of views, length, how many days ago it was shared, number of likes, number of comments received) was noted, and statistical analysis was performed.

Results: The median (interquartile range) number of views was 2012 (478-6877), the duration of the video in minutes was 2.47 (1.55-5.78), the number of days since the video was uploaded was 1234 (459-1611), the number of likes the video received was 19 (5-63), and the number of comments was 0 (0-4). The DISCERN scale was determined as 14 videos in group 1 and 16 videos in group 2. When general characteristics are compared with groups 1 and 2, a statistically significant difference was found between video length and groups 1 and 2. ($p<0.05$) The duration of the video content was longer in group 2. No statistically significant difference was found between other findings and groups 1 and 2.

Conclusion: When evaluated according to scales, it turns out that longer videos are of better quality. In today's technology, it is easy to access information but difficult to access accurate, reliable, and quality information. Therefore, physicians and academic institutions should provide high-quality, reliable videos of appropriate duration that contribute to informing patients and medical students. We believe that more videos uploaded by healthcare professionals and academic institutions will improve the quality of YouTube™ videos on thyroid ablation treatments.

Keywords: Thyroid ablation, YouTube, DISCERN, Global Quality Scale

INTRODUCTION

Thyroid diseases are a very common health problem in society and have many treatment options. Traditional treatment modalities include surgical resection, radioactive iodine therapy, and ablation techniques, which have become widespread recently.[1] Thyroid ablation is a minimally invasive method developed as an alternative to surgery, especially in benign nodules. In this method, a thin probe is inserted into the nodule under ultrasound guidance, and the target nodule is destroyed in a controlled manner.[2] Compared to surgery, it offers important advantages such as a lower risk of complications, application under local anesthesia, no need for hospitalization, and a faster recovery time.[3] With the gradual development of thyroid ablation surgical techniques, its safety and success compared to other methods have been demonstrated over the years.[4] Thyroid ablation was initially used in benign nonfunctional nodules; with the development of techniques, it has been tried in functional nodules, malignant thyroid nodules, and papillary thyroid microcarcinomas and found to be successful.[2,5] Medical information about thyroid ablation treatments has not yet taken its place in classical medical education. Therefore, the internet is frequently used as a source of information on this subject.

YouTube™ is the second most used social media platform and search engine today. This platform, which is used by approximately 2.1 billion people and has 76 different language options, has paved the way for its use for educational purposes.[6] Doctors, patients describing their experiences, and various health institutions share the videos they shoot in their fields on this platform for educational, advertising, and informational purposes. Patients use YouTube™ videos to get information about their diseases and treatments. However, patients are confused about the quality and reliability of the videos shared. There is no mechanism to evaluate the quality of videos on YouTube™.[7] In this study, videos accessed by entering keywords on the YouTube™ platform were evaluated. Our aim was to reveal the value of the content related to thyroid ablation on YouTube™ in terms of scientific accuracy, usefulness, and quality of information for patients and healthcare professionals.

METHODS

In this cross-sectional study, we evaluated the scientific quality of thyroid ablation videos on the YouTube™ platform on March 3, 2025. This study was conducted in Kırıkkale University Faculty of Medicine Hospital according to the principles of the Declaration of Helsinki after obtaining ethical approval from Kırıkkale University Non-interventional Researches Ethics Committee (Date: 12.02.2025, Decision No: 2025.02.39). Within the scope of the study, the videos were evaluated by medical students who did not have detailed information about thyroid ablation treatments. On the internet (after browser and cookies were cleared), 43 videos that appeared in searches on YouTube™ with the keywords "thyroid ablation procedure," "interventional thyroid ablation therapy," and "thyroid ablation procedure" were evaluated. Among the evaluated videos, 13 videos that did not meet our exclusion criteria (videos shot in languages other than English, mini videos, and silent videos with no informative content) were excluded from the study, and 30 videos were evaluated. We noted the duration of the videos, when they were uploaded, the number of likes, the number of comments, and the number of times they were viewed. The number of dislikes was not visible on YouTube™ content, as it is now shared only with the video uploader. Therefore, the video power index (VPI) could not be calculated. DISCERN scores and Global Quality Scale (GQS) scores were noted. The study was conducted in accordance with internet research ethics guidelines, and the researchers have no conflict of interest with the video content.

DISCERN Scale and Scoring System

The DISCERN questionnaire was developed for the objective assessment of video quality and reliability, and previous studies have used the DISCERN scoring system for the evaluation of YouTube™ videos.[8-10] The DISCERN scale consists of 3 parts that assess the reliability of the video (part 1), the quality of information about treatment options (part 2), and the overall quality of the information (part 3) (**Table 1**). The first part has 8 questions, and the second part has 7 questions. Section 3 includes an overall rating. Each question is scored on a 5-point scale (1-5). The videos were monitored by an independent evaluator group of medical students. Each item was scored on a scale of 1-5 (1: very poor, 5: excellent) (10). The DISCERN rating scale classifies quality levels; scores between 16 and 26 indicate very low quality, scores between 27 and 38 indicate low quality, videos with scores between 39 and 50 indicate moderate quality, scores between 51 and 62 indicate an acceptable quality standard, and videos with scores between 63 and 75 indicate exceptional quality.[10,11] Based on this, content above 50 points was categorized as useful and below 50 points as useless.[12]

Table 1. DISCERN scoring system

Section	Questions	No	Partly	Yes
Reliability	1. Explicit aims	1	2 3 4	5
	2. Aims achieved	1	2 3 4	5
	3. Relevance to patients	1	2 3 4	5
	4. Source of information	1	2 3 4	5
	5. Currency (date) of information	1	2 3 4	5
	6. Bias and balance	1	2 3 4	5
	7. Additional sources of information	1	2 3 4	5
	8. Reference to areas of uncertainty	1	2 3 4	5
Quality	9. How treatment works	1	2 3 4	5
	10. Benefits of treatment	1	2 3 4	5
	11. Risks of treatment	1	2 3 4	5
	12. No treatment options	1	2 3 4	5
	13. Quality of life	1	2 3 4	5
	14. Other treatment options	1	2 3 4	5
	15. Shared decision making	1	2 3 4	5
	16. The overall quality of the publication as a source of information	1	2 3 4	5

GQS

The GQS is a five-point scale used to assess video quality, presence of sufficient information, flow, and usefulness of videos.[13] The GQS of each video ranges from 1 to 5 points (1: poor quality, 5: excellent quality). Videos that are most useful and of excellent quality are considered five points (**Table 2**).

Table 2. Global quality scale criteria

Score	Global score description
1	Poor quality, poor flow of the site, most information missing, not at all useful for patients
2	Generally poor quality and poor flow, some information listed but many important topics missing, of very limited use to patients
3	Moderate quality, suboptimal flow, some important information is adequately discussed but others poorly discussed, somewhat useful for patients
4	Good quality and generally good flow, most of the relevant information is listed, but some topics are not covered, useful for patients
5	Excellent quality and excellent flow, very useful for patients

Statistical Analysis

The data analyses were conducted using SPSS v25 (IBM SPSS Statistics for Windows; Armonk, NY: IBM Corp.). The Shapiro–Wilk test was used to check the normality of data distribution. Continuous variables were presented as median (interquartile range) values and categorical variables for the non-normally distributed data. The Mann–Whitney U test was used to compare data groups with non-normally distributed data. $p<0.05$ was considered significant.

RESULTS

Since the distribution of the general characteristics of the 30 videos (number of views, duration of the video in minutes, number of days since the video was uploaded, number of likes the video received, number of comments) was not homogeneous, median (interquartile range) values were calculated (**Table 3**). The median (interquartile range) of the number of views was 2012 (478-6877), the duration of the video in minutes was 2.47 (1.55-5.78), the number of days since the video was uploaded was 1234 (459-1611), the number of likes the video received was 19 (5-63), and the number of comments was 0 (0-4) (**Table 3**). According to DISCERN scores, useless videos below 50 points were grouped as group 1, and videos above 50 points were grouped as useful content group 2. Accordingly, 14 videos were identified in group 1 and 16 videos in group 2. When general characteristics are compared with groups 1 and 2, a statistically significant difference was found between video length and groups 1 and 2 ($p<0.05$). The duration of the video content was longer in group 2. No statistically significant difference was found between other findings and groups 1 and 2 (**Table 4**). DISCERN scores and GQS scores were correlated. No correlation was found between the two scoring systems (**Table 5**).

Table 3. Basic characteristics of the analyzed videos

	n	Median (25-75)
Views	30	2012 (478-6877)
Length (min)	30	2.47 (1.55-5.78)
Duration	30	1234 (459-1611)
Likes	30	19 (5-63)
Comments	30	0 (0-4)

Data presented as median (interquartile range) values, Min: Minimum

Table 4. Comparison of variables between useful and not useful videos according to DISCERN

	DISCERN <50	DISCERN >50	p*
Views	1525 (309-8526)	2442 (656-3856)	0.739
Length	1.7 (1.3-2.3)	4.4 (2.5-10.5)	0.001
Duration	976 (370-1530)	1280 (656-1796)	0.360
Likes	13 (3-63)	20 (7-127)	0.298
Comments	0 (0-4)	0 (0-5)	0.980

* Mann-Whitney U test was used to compare data groups

Table 5. Correlation between quality scores

Variables		DISCERN	GQS
DISCERN	r	1	
	p		
GQS	r	0.294	1
	p	0.115	

GQS: Global Quality Score, r: Correlation coefficient, p: Statistically significant

DISCUSSION

Thyroid diseases are quite common today. In addition to periodic surgical approaches and drug therapies, ablation techniques have been developed. Ultrasound-guided ablation techniques are increasingly being incorporated into the routine treatment of thyroid lesions. New ablation methods, like radiofrequency ablation (RFA), microwave ablation (MWA), laser ablation (LA), and high-intensity focused ultrasound (HIFU), use high heat on the specific area to permanently affect the cells. Lesions that cause local symptoms or hyperfunction can be selectively treated with ultrasound guidance without damaging the entire gland.[14] In particular, RFA has lower complication rates than LA.[15] MWA, on the other hand, is faster and can produce higher energy compared to RFA because its working principle is different. It can ablate larger areas.[5] HIFU is a new thermal ablation technique that causes focused destruction with high heat while minimizing damage to surrounding tissues.[16] However, all of these treatments have gained popularity recently and have partially taken their place in classical medical education. Explaining these methods, which are applied by interventional radiologists, general surgeons, and endocrinologists, in new technological terms and illustrating the procedures keeps them up-to-date for patients and medical professionals. In today's technology, we live in the age of the Internet, and the Internet is actively used to access information. Technological innovation brings about significant transformations in education and social changes.[17] In the literature, there are studies showing that 8 out of 10 Internet users use the Internet to search for health-related information.[18] Patients, patient relatives, healthcare professionals, and medical students use the Internet very actively for learning in the field of health. The complex YouTube™ algorithm, which has a very effective place in these uses, is designed to navigate a pool of categorized videos and functions through a complex and constantly evolving process that is largely shaped by viewers' feedback and interactions.[19] It is important to note that in this complex and dynamic algorithm, search results for thyroid ablation treatments may change when performed by different users at different times. All of the videos we evaluated in our study were shared by health professionals. This could be because the topic we investigated is both new and technical. Nevertheless, when the quality values were grouped according to the DISCERN score, 14 videos were classified below 50 points. When we compared the general characteristics with groups 1 and 2, which we formed according to DISCERN scoring, we found a statistical correlation between video length and groups 1 and 2 ($p<0.05$). The duration of the video content was longer in group 2. There was no statistical correlation between other findings and groups 1 and 2. Keeping the content longer may make the videos more understandable. There was no statistical difference between GQS score and DISCERN score. This disparity may be due to the number of videos we evaluated. In studies to be conducted with more comprehensive content, the parallelism of the two scores can be determined. When the literature is evaluated, although we did not find any studies on this subject, there are many medical video evaluation studies conducted with YouTube™. Tutan et al.[12] evaluated YouTube™ videos on hepatosteatosis and found that the quality assessment of videos shared by healthcare professionals was higher. In the same study, no significant difference was found between the number of views and the uploader group, the time elapsed since uploading, the number of subscribers, and the number of views. In another study, videos related to fibromyalgia were evaluated, and no statistically significant correlation was found between

DISCERN scores and the rate of likes, number of likes, number of dislikes, number of comments, and number of views.[20] In our study, we did not find a difference between the number of views and quality. We can think that the quality of the content does not affect the viewing rates, so each piece of content affects daily life independently of quality.

Limitations

There are some limitations in our study. First of all, YouTube™ is a dynamic sharing network, and the content and number of videos can change rapidly. Our study was conducted over a certain period of time. Our study did not include YouTube™ videos in any language other than English. The evaluation was done by a single group. Better results could be obtained with different groups or individuals. In addition, we searched for YouTube™ videos with specific keywords. Other posts were not evaluated. We couldn't compare video quality with other users because all the videos we evaluated were shared by healthcare professionals. In addition, the number of videos we evaluated was small. We think that better results can be obtained with more detailed studies as the number of posts on this subject increases.

CONCLUSION

Our study indicated that YouTube™ English videos of thyroid ablation videos are accessible sources of information for medical students. Our findings revealed that some of the YouTube™ English videos on thyroid ablation treatments were of low quality, and videos with higher quality content were longer in duration. In conclusion, the quality of information on YouTube™ is variable. In today's technology, it is easy to access information but difficult to access accurate, reliable, and high-quality information. Therefore, doctors and academic institutions should provide high-quality, reliable videos of appropriate duration that contribute to informing patients and medical students. Such materials will prevent patients, medical professionals, and students from being misinformed or misinformed. We believe that more video uploads by healthcare professionals and academic institutions will improve the quality of YouTube™ videos on thyroid ablation treatments.

ETHICAL DECLARATIONS

Ethics Committee Approval

This study was obtained from Kırıkkale University Non-interventional Researches Ethics Committee (Date: 12.02.2025, Decision No: 2025.02.39).

Informed Consent

Since the data is taken from publicly available YouTube, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Haugen BR, Alexander EK, Bible KC, et al. 2015 American Thyroid Association management guidelines for adult patients with thyroid nodules and differentiated thyroid cancer. *Thyroid*. 2016;26(1):1-133. doi:10.1089/thy.2015.0020
2. Papini E, Monpeyssen H, Frasoldati A, Hegedüs L. 2020 European Thyroid Association clinical practice guideline for the use of image-guided ablation in benign thyroid nodules. *Eur Thyroid J*. 2020;9(4):172-185. doi:10.1159/000508484
3. Na DG, Lee JH, Jung SL, et al. Radiofrequency ablation of benign thyroid nodules and recurrent thyroid cancers: consensus statement and recommendations. *Korean J Radiol*. 2022;23(1):12-26. doi:10.3348/kjr.2012.13.2.117
4. Yang Z, Pan XH, Han HT, Zhao YX, Ma LB. Progress in research on ablation of thyroid nodules. *Endokrynol Pol*. 2024;75(3):262-66. doi:10.5603/ep.98908
5. Cui T, Jin C, Jiao D, Teng D, Sui G. Safety and efficacy of microwave ablation for benign thyroid nodules and papillary thyroid microcarcinomas: a systematic review and meta-analysis. *Eur J Radiol*. 2019;118:58-64. doi:10.1016/j.ejrad.2019.06.027
6. Osman W, Mohamed F, Elhassan M, Shoufan A. Is YouTube a reliable source of health-related information? A systematic review. *BMC Med Educ*. 2022;22(1):382. doi:10.1186/s12909-022-03446-z
7. Ozturkmen C, Berhuni M. YouTube as a source of patient information for pterygium surgery. *Ther Adv Ophthalmol*. 2023;15:25158414231174143 doi:10.1177/25158414231174143
8. Cetin HK, Koramaz I, Zengin M, Demir T. The evaluation of YouTube™ English videos' quality about coronary artery bypass grafting. *Sisli Etfal Hastan Tip Bul*. 2023;57(1):130-135. doi:10.14744/SEMB.2022.59908
9. Yalkin O, Uzunoglu MY, İflazoglu N, Esen E. Are YouTube Videos a reliable source for obtaining information about colorectal cancer screening? *Cureus*. 2022;14(1):e21550. doi:10.7759/cureus.21550
10. Charnock D, Shepperd S, Needham G, Gann R. DISCERN: an instrument for judging the quality of written consumer health information on treatment choices. *J Epidemiol Community Health*. 1999;53(2):105-111. doi:10.1136/jech.53.2.105
11. Kaicker J, Borg Debono V, Dang W, Buckley N, Thabane L. Assessment of the quality and variability of health information on chronic pain websites using the DISCERN instrument. *BMC Med*. 2010;8(1):59. doi:10.1186/1741-7015-8-59
12. Tutan D, Kaya M. Evaluation of YouTube videos as a source of information on hepatosteatosis. *Cureus*. 2023;15(10):e46843. doi:10.7759/cureus.46843
13. Zengin O, Onder ME. Educational quality of YouTube videos on musculoskeletal ultrasound. *Clin Rheumatol*. 2021;40(10):4243-4251. doi:10.1007/s10067-021-05793-6
14. Richter JP, Richter CP, Gröner D. Ultraschallgeführte lokalablative verfahren zur behandlung von schilddrüsenläsionen [Ultrasound-guided ablation techniques for thyroid lesions]. *Laryngorhinootologie*. 2023;102(12):916-927. doi:10.1055/a-1979-9184
15. Lim HK, Lee JH, Ha EJ, Sung JY, Kim JK, Baek JH. Radiofrequency ablation of benign non-functioning thyroid nodules: 4-year follow-up results for 111 patients. *Eur Radiol*. 2013;23(4):1044-1049. doi:10.1007/s00330-012-2671-3
16. Esnault O, Franc B, Monteil JP, Chapelon JY. High-intensity focused ultrasound for localized thyroid-tissue ablation: preliminary experimental animal study. *Thyroid*. 2004;14(12):1072-1076. doi:10.1089/thy.2004.14.1072
17. Garrison DR. E-learning in the 21st century: a framework for research and practice. 2nd ed. New York: Routledge; 2011.
18. Wasserman M, Baxter NN, Rosen B, Burnstein M, Halverson AL. Systematic review of internet patient information on colorectal cancer surgery. *Dis Colon Rectum*. 2014;57(1):64-69. doi:10.1097/DCR.0000000000000011
19. Fyfield M, Henderson M, Phillips M. Navigating four billion videos: teacher search strategies and the YouTube algorithm. *Learn Media Technol*. 2021;46(1):47-59. doi:10.1080/17439884.2020.1781890
20. Ozsoy-Unubol T, Alanbay-Yagci E. YouTube as a source of information on fibromyalgia. *Int J Rheum Dis*. 2021;24(2):197-202. doi:10.1111/1756-185X.14043

Journal of Radiology Medicine in

Case Report

Doi: 10.51271/JRM-0029

A rare intra-abdominal mass in a newborn: gastric teratoma

Mehmet Haydar Atalar[1], Nisa Başpınar[1], Hatice Özer[2], Cengiz Güney[3]

[1]Department of Radiology, Faculty of Medicine, Sivas Cumhuriyet University, Sivas, Turkiye
[2]Department of Patology, Faculty of Medicine, Sivas Cumhuriyet University, Sivas, Turkiye
[3]Department of Pediatric Surgery, Faculty of Medicine, Sivas Cumhuriyet University, Sivas, Turkiye

Received: 07.03.2025 ◆ **Accepted**: 15.04.2025 ◆ **Published**: 26.04.2025

Cite this article: Atalar MH, Başpınar N, Özer H, Güney C. A rare intra-abdominal mass in a newborn: gastric teratoma. *J Radiol Med.* 2025;2(2):36-38.

Corresponding Author: Mehmet Haydar Atalar, mhatalar@gmail.com

ABSTRACT

Gastric teratomas are rare intra-abdominal tumors. They are frequently seen in the neonatal period. A palpable mass is the most common clinical sign. Although radiologic imaging plays a role in diagnosis, in most cases the final diagnosis is made by histopathologic examination. In this report, we present a newborn male patient diagnosed with immature gastric teratoma. A male infant was referred to the clinic due to bloating and a palpable abdominal mass. Ultrasonography revealed a complex solid cystic mass in the abdominal and pelvic region. Magnetic resonance imaging was recommended. MRI revealed a multilocular, multiseptated, complex lesion. Given the radiologic findings, a gastric teratoma was suspected. The patient underwent surgery. On histopathologic examination, an immature grade 3 teratoma was diagnosed. Gastric teratomas are extremely rare tumors and must be considered in the differential diagnosis of abdominal masses during the neonatal and infant period.

Keywords: Teratoma, stomach, magnetic resonance imaging, neoplasm, pathology

INTRODUCTION

Gastric teratoma is an extremely rare tumor. The first case of gastric teratoma was reported by Eusterman and Sentry in 1922. About 100 cases have been described in the literature.[1] Most cases have been detected in the neonatal period. The majority of lesions are exogastric in location. Gastric teratomas are often of the mature type. It can sometimes be difficult to make a preoperative diagnosis.[1,2]

This case report discusses the radiologic and pathologic findings of a patient diagnosed with a gastric teratoma due to an intra-abdominal complex cystic lesion in the neonatal period.

CASE

A male infant born with a birth weight of 2289 grams and a height of 47 cm to a 32-year-old mother at 34 weeks' gestation and 2 days' gestation had a postnatal APGAR score of 4-6. The patient was taken to the neonatal intensive care unit where cardiopulmonary resuscitation was performed as the peak heart rate was below 60/minute. Physical examination revealed a distended abdomen and a palpable abdominal mass, so an abdominal radiograph and ultrasonography (US) were performed. The abdominal radiograph showed soft tissue radiolucency in the left abdomen and displacement of the bowel structures to the right (**Figure 1a**). The ultrasound examination revealed a multilocular, multiseptated, complex cystic solid mass that almost completely filled the abdominal and pelvic region. Abdominal magnetic resonance imaging (MRI) was performed to characterize the lesion. MRI showed a multilocular, multiseptate, expandable, complex mass that was hypointense on T1-weighted (T1W) images and hyperintense on T2-weighted (T2W) images. The mass filled the entire abdominal cavity and compressed the liver, spleen and intestinal structures. The stomach could not be distinguished. Diffusion of its solid components was limited on diffusion-weighted images. The septal structures showed contrast uptake in the T1W post-contrast series (**Figure 1b, 1c, 1d**). Given the imaging findings, a cystic teratoma was primarily considered as a differential diagnosis. Preoperative examination of the patient revealed thrombocytopenia, decreased urine output and an elevated D-dimer level. His alpha-fetoprotein level was within normal age limits. After preoperative treatment, the patient was taken for surgery. At laparotomy, the cystic component of the mass was initially noted. It was found that the integrity of the lesion was disturbed and bleeding occurred on the medial side of the cystic component. The spleen was connected to the upper left part of the lesion. It was observed that the mass was associated with the smaller curvature of the stomach.

On examination of the gastric fundus, a bony structure was palpated. The mass was explored and then a gastric repair and total splenectomy were performed.

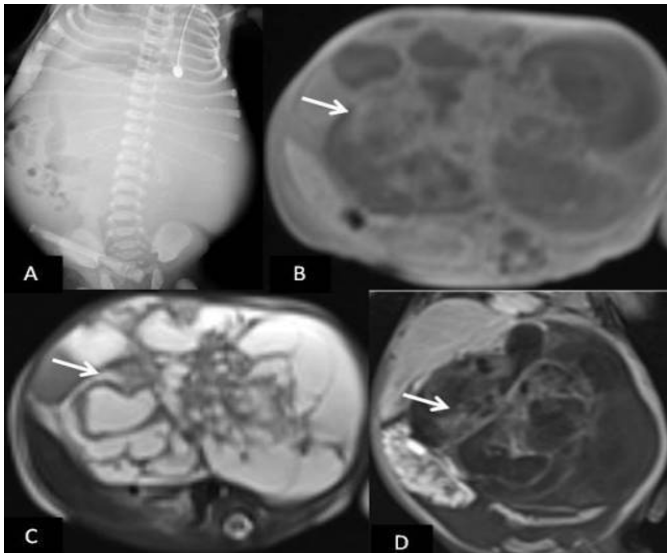


Figure 1. (**A**) A plain abdominal radiograph shows soft tissue radiolucency on the left side of the abdomen and a shift of the bowel structures to the right. Axial (**B**) T1W and (**C**) T2W MR images show a complex mass with a cystic solid structure located predominantly on the left side of the abdominal cavity. (**D**) A coronal post-contrast T1W MR image shows marked contrast enhancement of the solid components of the lesion

In the pathology report, the macroscopic examination of the material from the partial gastric resection showed a tumor measuring 10x9x6 cm and weighing 200 g, which was adjacent to the stomach wall and included the spleen on one side. The sections of the tumor consisted of patchy friable and hemorrhagic solid areas and cystic structures. Microscopic examination revealed mature elements of all three germ layers (fibrous tissue, cartilage, bone, squamous epithelium, lining epithelium of the airway and gastrointestinal tract, neuroglial tissue, choroid plexus) as well as a high proportion of immature neuroectodermal components and rosette formations (**Figure 2, 3**). The histopathology of the lesion was classified as an immature grade 3 teratoma. The patient died on the fifth day of his life due to respiratory distress. The patient's parents had given their written consent for this study.

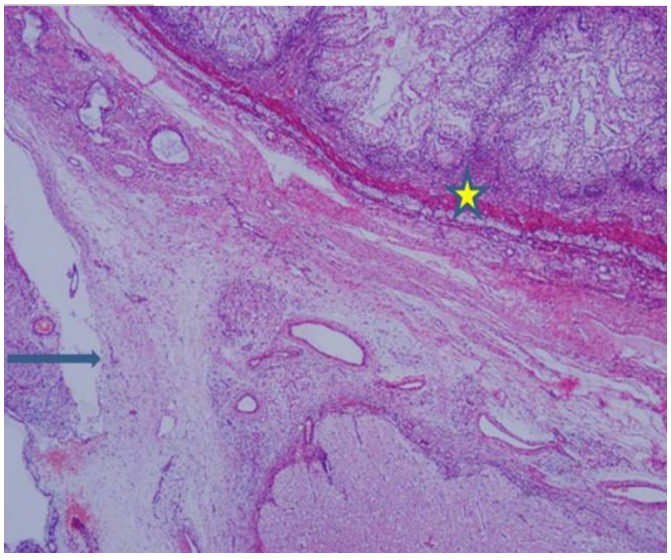


Figure 2. Microscopic view of the tumor in the submucosa of the stomach (H&E; X40) (Asterisk; gastric mucosa and arrow; gastric teratoma)

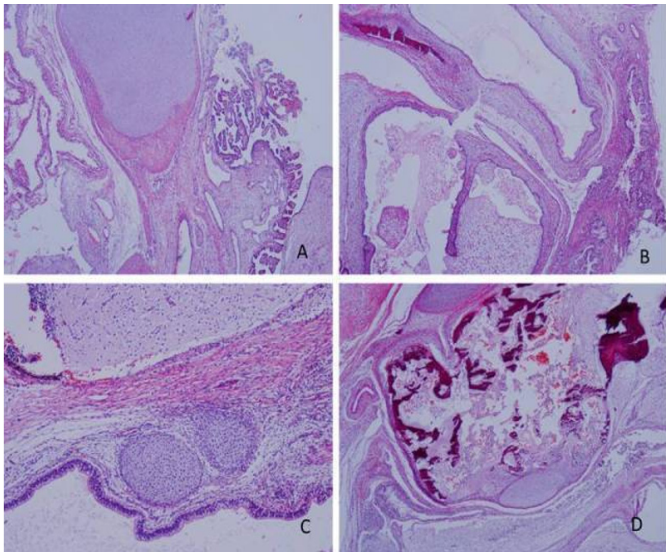


Figure 3. Microscopic images of mature elements from different areas: **A**: cartilage, epithelial elements and choroid plexus. **B**: Bone, cystic formations lined by squamous epithelium, the intestinal epithelium on the right side. **C**: Mature neuroglial tissue, cartilage, columnar ciliated epithelium underneath. **D**: Bone and bone marrow elements, cartilage and epithelial elements (A-D: H&E; X40).

DISCUSSION

Teratomas are tumors that arise from the three germ layers. They usually have a gonadal or extragonadal localization. Extragonadal teratomas occur more frequently in newborns, infants and young children. Gastric teratomas are the most common gastrointestinal teratomas, although they account for only 1% of all body teratomas. Clinically, most patients complain of a palpable mass in the epigastrium and on the left side of the abdomen (75%), abdominal distension and vomiting. In some cases, however, other symptoms such as gastrointestinal bleeding or stomach perforation have also been reported.[1] Other rare findings include peritonitis due to gastric perforation and tumor rupture.[2] Gastric teratomas frequently contain cystic and solid components. The tumors are usually located exogastrically. The most common site is the posterior wall of the stomach, followed by the lesser curvature of the stomach and the anterior wall of the stomach.[3,4]

Radiologic imaging studies often show a complex mass composed of solid and cystic components. Although half of all gastric teratomas show calcification on radiography, this is a nonspecific sign. US shows a heterogeneous mass with mixed echogenicity. Contrast-enhanced CT can be used to show the location, relationship to neighboring organs and vascular structures, and metastatic status of a mass lesion. While MRI shows a heterogeneous mass with cystic and solid components, it cannot adequately determine calcification. MRI can clearly determine the size of a tumor mass and differentiate its solid and cystic components.[5-7]

The most important indicator for the prognosis of teratomas is the histopathological grade of the tumor. Mature teratomas are considered benign and are classified as grade 0. Immature teratomas are classified according to the Norris classification system from grade 1 to grade 3, taking into account the content of immature tissue (mostly neural elements) and the degree of mitotic activity. Pure grade 1 and 2 teratomas have the potential to become malignant, while pure grade 3 teratomas have the potential to metastasize.[8,9]

The differential diagnosis of gastric teratoma includes gastric stromal tumors, neuroblastoma, ganglioneuroblastoma, ganglioneuroma, mesoblastic nephroma, Wilms tumor, rhabdomyosarcoma, pancreatic cyst, hepatoblastoma, liposarcoma, meconium pseudocyst, and retroperitoneal teratoma. When solid, cystic and calcified intra-abdominal lesions are detected in the left upper quadrant of the abdomen in the pediatric age group, congenital neuroblastoma and gastric teratoma should be considered first in the differential diagnosis. Gastrointestinal stromal tumors are the most common stomach tumors in childhood. However, they are rare in newborns. They are usually characterized by cystic necrotic areas and rare calcifications and present as focal polypoid, primarily exogastric masses with intragastric extension but without intralesional fat.[4-9] The association of gastric teratomas with Beckwith-Wiedemann syndrome and peritoneal gliomatosis has also been described in the literature.[10]

Complete surgical resection is sufficient for the treatment of mature teratomas and grade 1 immature teratomas. Complete resection followed by close surveillance and follow-up is recommended for grade 2 and 3 immature teratomas, while chemotherapy is indicated for recurrence.[7,8,11] When a mature teratoma contains intestinal tissue or an immature teratoma is present, the serum alpha-fetoprotein level is abnormally elevated in an age-dependent manner. Alpha-fetoprotein and beta-chorionic gonadotropin levels aid in the detection of a tumor or its recurrence and malignant transformation during follow-up.[8,9]

CONCLUSION

Gastric teratoma is a very rare tumor that occurs mainly in the neonatal and infant period. In our case, a large, complex cystic intra-abdominal mass was discovered in the neonatal period and diagnosed by advanced imaging techniques. A gastric teratoma should always be considered in the differential diagnosis when a large intra-abdominal mass is discovered in the neonatal period. Early diagnosis and surgical removal are the mainstays of treatment, although immature teratomas may require more aggressive follow-up and additional oncologic treatments.

ETHICAL DECLARATIONS

Informed Consent

The patient's parents signed a free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Kumar V, Godara R, Bharadwaj R, Arora M. Gastric teratoma-unusual cause of neonatal obstructive jaundice: a case report. *Indian J Surg*. 2013; 75(Suppl 1):421-424. doi:10.1007/s12262-012-0728-9
2. Al-Salem AH. Immature gastric teratoma in a newborn. *Med Case Stud*. 2012;32:12-16. doi:10.5897/MCS12.008
3. Herman TE, Siegel MJ. Congenital gastric teratoma. *J Perinatol*. 2008; 28(11):786-787. doi:10.1038/jp.2008.85
4. Gupta DK, Srinivas M, Dave S, Agarwala S, Bajpai M, Mitra DK. Gastric teratoma in children. *Pediatr Surg Int*. 2000;16(5-6):329-332. doi:10.1007/s003830000390
5. Yadav A, Mathur A, Jindal A, Malhotra H. Immature gastric teratoma: a rare tumour. *Adv Hum Biol*. 2017;7(3):142-144. doi:10.4103/AIHB.AIHB_51_17
6. Aihole JS, Babu MN, Jadhav V, Javaregowda D. Gastric teratoma: an unusual presentation and location. *Indian J Med Paediatr Oncol*. 2017; 38(4):563-565. doi:10.4103/ijmpo.ijmpo_182_16
7. Beavers AJ, Khan A, Uddin N, Weakley DL, Setoodeh S, Pfeifer CM. Multimodal depiction of a rare immature gastric teratoma from fetus to infant. *Radiol Case Rep*. 2018;14(3):372-376. doi:10.1016/j.radcr.2018.12.003
8. Hasan R, Monappa V, Kumar S, Kumar V. Large gastric teratoma: a rare intra-abdominal mass of infancy. *Oman Med J*. 2016;31(3):231-234. doi:10.5001/omj.2016.44
9. Osama MA, Chatterjee P, Singh S, Sarin YK. Mature cystic teratoma of stomach in a 6-year-old child: usual tumor at an unusual location. *Indian J Pathol Microbiol*. 2023;66(1):205-206. doi:10.4103/ijpm.ijpm_991_21
10. Falik-Borenstein TC, Korenberg JR, Davos I, et al. Congenital gastric teratoma in Wiedemann-Beckwith syndrome. *Am J Med Genet*. 1991; 38(1):52-57. doi:10.1002/ajmg.1320380113
11. Li B, Wei K. A case of neonatal gastric teratoma complicated with occult gastrointestinal hemorrhage misdiagnosed as lymphangioma. *Turk J Pediatr*. 2025;67(1):123-128. doi:10.24953/turkjpediatr.2025.5148

Journal of Radiology Medicine in

Case Report

Doi: 10.51271/JRM-0030

The many radiologic faces of filamin A mutation in 2-year-old girl: a case report

Özlem Özkale Yavuz, Birsel Şen Akova

Department of Pediatric Radiology, Ankara Bilkent City Hospital, Ankara, Turkiye

Received: 27.03.2025 ◆ **Accepted**: 15.04.2025 ◆ **Published**: 26.04.2025

Cite this article: Özkale Yavuz Ö, Şen Akova B. The many radiologic faces of filamin A mutation in 2-year-old girl: a case report. *J Radiol Med.* 2025;2(2):39-42.

Corresponding Author: Özlem Özkale Yavuz, drozlemozkale@hotmail.com

ABSTRACT

In this article, we present the case of a 2-year-old girl with filamin A (FLN-A) mutation who exhibited thrombocytopenia, corpus callosum hypoplasia with periventricular nodular heterotopia (PNH), bicuspid aortic valve, mild pulmonary hypertension, bilateral lung hyperinflation, and gastroesophageal reflux. FLN-A is an actin-binding protein, expressed throughout the body that has several functions in cell signaling and preservation of cell shape and migration. Mutation in the FLNA gene is associated with a diverse array of disorders, including neuronal migration abnormality, and anomalies of connective and vascular tissue. Abnormal FLNA interactions can affect pulmonary viscoelastic properties, disrupt alveolar formation and growth, and cause alveolar growth abnormalities, leading to alveolar simplification, emphysematous changes, and pulmonary arteriopathy. In addition, defects in cell migration during embryonic development is also another mechanism of the development of congenital cortical malformations and lung abnormalities. The patient was presented with vomiting, desaturation during feeding, a need for supplemental oxygen, and cyanosis. Computed tomography imaging revealed the presence of lung disease with lung hyperinflation, and pulmonary hypertension. Additionally, cerebral PNH and corpus callosum hypoplasia, and gastroesophageal reflux were also identified by different imaging modalities. This case highlights the significance of various imaging findings in facilitating the early diagnosis of FLNA mutations and underscores the necessity of genetic testing. It also enhances our understanding of the wide spectrum of conditions associated with this mutation.

Keywords: Filamin A mutation, heterotopia, lung disease, children

INTRODUCTION

Filamins are one of the critical actin-binding cytoskeletal proteins that contribute significantly to the formation and maintenance of cellular architecture and morphology. They play essential roles in processes such as cell signaling and transcription, and their expression is observed across various tissues in the body.[1,2] Notably, mutations in filamin A (FLN-A) can lead to a range of developmental malformations affecting multiple organ systems in children. These mutations are particularly associated with defects in neuronal migration, vascular function, and the integrity of connective tissues.[3]

Macrothrombocytopenia frequently presents alongside the FLN-A mutation, which leads to the early release of fragile and immature platelets with a shortened lifespan.[4] Mutations in the FLN-A gene lead to myxomatous mitral valve disease, non-syndromic mitral valve dystrophy, familial Ebstein's anomaly, and prolapsed atrioventricular valves.[5,6] Pulmonary manifestations consist of a wide range of pulmonary disorders that occur during early childhood and include neonatal respiratory failure, severe bronchopulmonary dysplasia, congenital emphysema, atelectasis, interstitial lung disease, recurrent respiratory infections, and pulmonary hypertension.[6-8] Reduced intestinal motility, and congenital idiopathic intestinal pseudo-obstruction often with microcolon are the gastroenterological findings that are frequently described.[9] Periventricular nodular heterotopia (PNH) at the lateral ventricular rim, large cisterna magna, and hypoplasia of the cerebellum and corpus callosum are strongly associated with FLN-A mutations.[10,11]

In the pediatric literature, a significant proportion of studies have focused on clinical perspectives concerning specific systems, including neurological, respiratory, cardiovascular, and musculoskeletal systems.[1,2,5-13] There are also articles that exclusively evaluate adult populations.[5,14,15] To our knowledge, FLN-A mutation-associated multisystem involvement has not been reported radiologically before.

CASE

A 2-year-old girl was admitted to the emergency department due to vomiting and acute respiratory distress. Upon evaluation, she exhibited peroral cyanosis, and desaturation while feeding and heart murmur. The baby (third child of consanguineous parents) was born via cesarean section at 37 weeks of gestation, with a birth weight of 2140 grams. The two years of her life was unremarkable. The family had no history of genetic or metabolic diseases or congenital disorders. On admission, the physical examination confirmed signs of respiratory distress, peroral cyanosis, a heart murmur, poor weight gain, and joint laxity. Laboratory investigations revealed thrombocytopenia (124 x10^3/ml) and coagulopathy. An echocardiogram showed the presence of a bicuspid aortic valve, patent ductus arteriosus, and mild pulmonary hypertension, with a mean pulmonary arterial (PA) pressure of 20 mmHg, which is near the threshold for pulmonary hypertension. The child's condition deteriorated with worsening respiratory distress; the child was unable to maintain saturation even with oxygen support. An AP chest radiograph showed nonspecific bilateral fibroatelectatic areas. A chest computed tomography (CT) scan revealed hyperinflation of the anterior segments of both lungs, along with subsegmental atelectasis and pleuroparenchymal fibrotic changes (**Figure 1**) in the posterior segments. Indeed, the ratio of the main pulmonary artery (pulmonary trunk) to the ascending aorta was recorded at 1.3 (**Figure 1**), surpassing the critical threshold of 1.09, which correlated with elevated PA pressure. After stabilizing the respiratory status through non-invasive support, fluid and electrolyte management, broad-spectrum antibiotics, and bronchodilators, a decision was made to observe the case further. The patient underwent upper gastrointestinal tract fluoroscopy and the gastroesophageal reflux extending to the mid-segment of the esophagus was detected. A cranial ultrasound raised suspicion for dysplasia of the corpus callosum, which was later confirmed by MRI showing thinning of the corpus callosum consistent with hypoplasia (**Figure 2**) for the patient's age. Multiple nodular lesions which are similar gray matter signals along the bilateral subependymal region evaluated as gray matter heterotopia (**Figure 2**). Additionally, a focal enlargement of cerebrospinal fluid (CSF) was also observed in the posterior fossa (**Figure 2**).

With these multisystemic imaging findings, the diagnosis of FLN-A mutation was suspected. In order to confirm the diagnosis, specific molecular testing for mutations of the FLN gene was performed and the final diagnosis was confirmed by the detection of duplicated heterozygous FLN-A mutation in our patient.

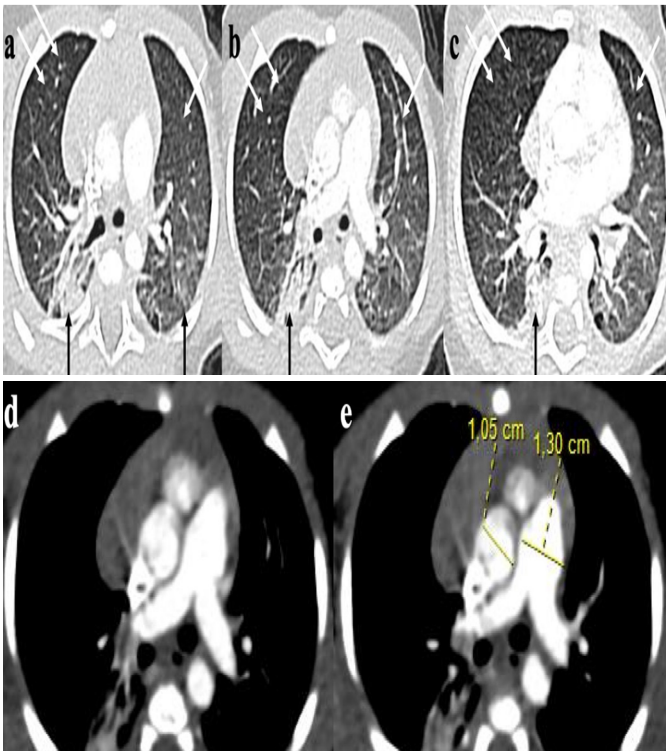


Figure 1a-e. Axial contrast-enhanced chest CT images demonstrate hyperinflation areas in the anterior segments of both lungs (**a, b,** and **c:** white arrows). Additionally, there is evidence of subsegmental atelectasis, and pleuroparenchymal fibrotic changes observed in the posterior segments of bilateral lungs (**a, b** and **c:** black arrow). A prominent finding is the increased ratio of main pulmonary artery (pulmonary trunk) to ascending aorta (**d, e**), which correlates with elevated pulmonary artery pressure, suggestive of pulmonary hypertension.

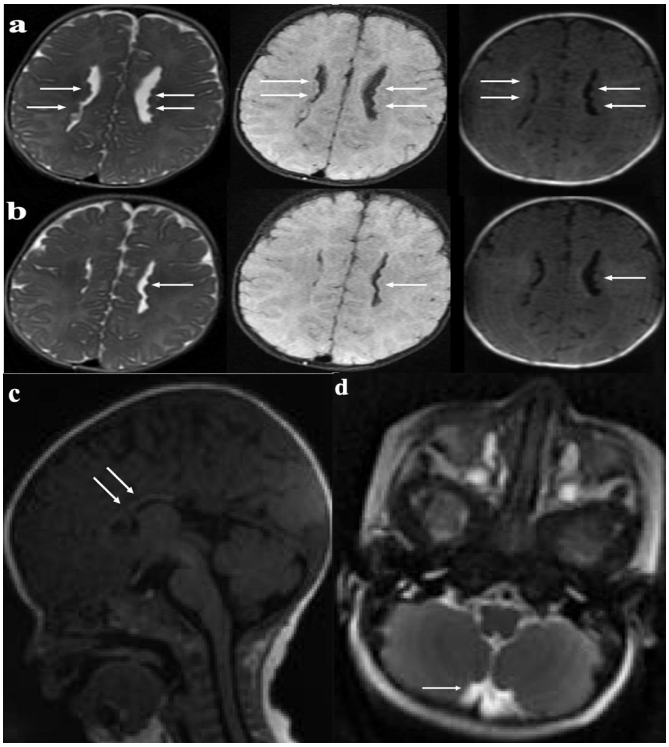


Figure 2a–d. The axial **(a, b)** T2-weighted, FLAIR, and T1-weighted turbo spin-echo (TSE) imaging reveals multiple nodules of heterotopia (arrows) gray matter remain isointense with the cortical gray matter lining along the body of lateral ventricles. Additionally, the sagittal 3D MPR image **(c)** demonstrates that a thinning of the corpus callosum according to age. Furthermore, there is a small focal cerebrospinal fluid (CSF) enlargement **(d)** at the posterior fossa

DISCUSSION

FLN-A is a ubiquitous phosphoprotein that links actin filaments and cytoskeleton to the plasma membrane. Moreover, being a structural component of the cytoskeleton, FLN-A has also been implicated in regulating many cellular signaling pathways and growth factors. The mutations in the FLN-A gene are associated with various multisystem abnormalities that affect all organs, including the brain, lungs, heart, bones, and skin.[1-3] The clinical heterogeneity of FLN-A mutations is extremely high as in our case.[13,15,16] Our case describes many specific and/or nonspecific radiological findings of multisystem involvement (periventricular heterotopia, corpus callosum hypoplasia, lung hyperinflation, pulmonary hypertension, and gastroesophageal reflux) and to our knowledge, FLN-A mutation associated multisystem involvement has not been reported radiologically before.

Macrothrombocytopenia is commonly shown in literature with FLN-A-associated periventricular heterotopia. It is thought that due to the premature fragile, immature platelets that have shorter life.[4] Our case had also decreased platelet counts with associated periventricular heterotopia, similar to the literature.

Multivalvular diseases have been commonly reported previously in the literature. Mitral valve disease affects 2-3% of the population and, as patients age, often requires corrective surgery. Myxomatous degeneration of the valves and regurgitation and prolapse of one or more of the aortic and mitral valves, sometimes with concomitant stenosis, have been seen frequently in boys. Females often have valve abnormalities, but most are asymptomatic. A smaller percentage of girls with familial valvular dystrophy develop mitral prolapse.[5,6] Bicuspid aortic valve (BAV) is the most frequent congenital heart disease, with an incidence of approximately 1%. It can be asymptomatic and associated with normal valve function. However, a series of complications, may develop valve incompetence to sudden death. The association of periventricular heterotopia with polivalvular disease and the BAV has been reported seldom in the literature as in our case.[17]

This rare entity may lead to chronic lung disease affecting mainly children (especially infant/toddler age group) and female individuals. It is part of the entities included in the childhood interstitial lung disease group of disorders and one of the etiologic factors of pulmonary hypertension. Recently, several pulmonary manifestations have been described including early respiratory failure, bronchopulmonary dysplasia, and imaging findings of pulmonary abnormalities were airway anomalies that included lung hyperinflation, lobar emphysema, and bronchial wall-thickening in association with interstitial changes such as peribronchial and interlobular septal thickening, ground glass opacification, severe lung airway cartilage deficiency, and abnormal elastic fibers in many studies.[6-8] Chest radiographs are still the mainstay of chest imaging. However, findings may be nonspecific and very subtle. CT helps to evaluate the major vessels and is superior to roentgenograms in many ways, detecting imaging findings that may be related to the underlying etiology; therefore, it is preferred despite the higher radiation risk. In our case, the patient presents with respiratory failure clinically and pulmonary hypertension on echocardiogram. The patient's chest CT findings were similar to previous studies, with hyperinflation in bilateral lung apical-anterior segments, atelectatic and pleuroparenchymal fibrotic changes in posterior segments, and vascular findings supporting pulmonary hypertension.

Due to the loss of FLN-A expression in intestinal smooth muscle, abnormal smooth muscle stratification may be seen during development, and this leads to decreased intestinal motility. Intestinal obstruction in the absence of a mechanical lesion is called congenital idiopathic intestinal pseudoobstruction. Patients variably present with decreased intestinal motility and a short, malrotated, and dilated small intestine, often with microcolon. This is often accompanied by failure to maintain body weight and growth and often leads to dependence on parenteral nutrition.[9] Gastroesophageal reflux disease is a clinical condition that affects millions of people worldwide and negatively impacts the quality of life. It is the involuntary retrograde passage of gastric contents into the esophagus with or without regurgitation and is considered a normal physiologic process, occurring daily in greater than one-third of all infants. However, it is accepted as a pathologic condition associated with poor weight gain, irritability, and dysphagia and often requires evaluation and treatment. Iqbal et al.[18] presented 4 cases and two of them had gastroesophageal reflux disease requiring Nissen and gastrostomy tube. Our patient also had gastroesophageal reflux accompanied by poor weight gain, suggesting that it was pathological. Even if gastroesophageal reflux is nonspecific, it may be useful to expand the manifestations of the disease.

PNH is a congenital brain malformation that is clinically diagnosed based on the imaging findings of heterotopic nodules composed of disorganized neurons along the lateral ventricles of the brain and often associated with epilepsy. The patients generally are of normal intelligence, although there have been associated findings of learning disabilities, namely, dyslexia. Parrini et al.[11] showed bilateral PNH, featuring contiguous heterotopic nodules, mega cisterna magna, cardiovascular malformations, and epilepsy that are associated with FLN-A mutations.[10,11] Pardoe et al.[19] specifically reported morphometric abnormalities in the corpus callosum in PNH and Lu et al.[2] described the corpus callosum in patients with PNH-associated epilepsy with FLNA mutation. We detected bilateral periventricular heterotopia, decreased caliber of corpus callosum evaluated as corpus callosum hypoplasia, and focal CSF enlargement in the posterior fossa, as described in the literature.

CONCLUSION

Mutation in the FLNA gene causes a wide spectrum of diseases including neuronal migration abnormality, and connective and vascular tissue anomalies notably interstitial lung diseases, pulmonary hypertension, myxomatous polyvalvular diseases, malformations of cortical development, periventricular heterotopia, migration anomalies, epilepsy, and decreased intestinal motility. Diseases associated with FLNA variants demonstrate considerable genetic and clinical heterogeneity. In this context, radiological findings are essential and invaluable for accurate diagnosis. Although many of these radiological findings may initially appear nonspecific and irrelevant, radiologists should keep imaging findings in mind and properly guide clinicians for comprehensive genetic evaluations. Such assessments aid in achieving prompt genetic diagnoses, which can significantly improve the patient's survival and social functionality in later life. Despite the rarity of this disorder and the relatively mild clinical presentation, this particular case presents an invaluable radiological perspective on multisystem involvement. It broadens our understanding of the spectrum of presentations associated with FLNA mutations and underscores the several imaging findings that clinicians should consider. These insights are essential for guiding advanced genetic investigations aimed at the early diagnosis of FLNA mutations.

ETHICAL DECLARATIONS

Informed Consent

The parents of patient signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

REFERENCES

1. Zhou X, Borén J, Akyurek LM. Filamins in cardiovascular development. *Trends Cardiovasc Med*. 2007;17(7):222-229. doi:10.1016/j.tcm.2007.08.001
2. Lu J, Lian G, Lenkinski R, et al. Filamin B mutations cause chondrocyte defects in skeletal development. *Hum Mol Genet*. 2007;16(14):1661-1675. doi:10.1093/hmg/ddm114
3. Robertson SP, Twigg SR, Sutherland-Smith AJ, et al. Localized mutations in the gene encoding the cytoskeletal protein filamin A cause diverse malformations in humans. *Nat Genet*. 2003;33(4):487-491. doi:10.1038/ng1119
4. Begonja A, Hoffmeister K, Hartwig J, Falet H. FLNA-null megakaryocytes prematurely release large and fragile platelets that cirulate poorly. *Blood*. 2013;118(8):2285-2295. doi:10.1182/ blood-2011-04-348482
5. Le Tourneau T, Le Scouarnec S, Cueff C, et al. New insights into mitral valve dystrophy: a filamin-A genotype–phenotype and outcome study. *Eur Hear J*. 2017;39(15):1269-1277. doi:10.1093/eurheartj/ehx505
6. Deng X, Li S, Qiu Q, et al. Where the congenital heart disease meets the pulmonary arterial hypertension, FLNA matters: a case report and literature review. *BMC Pediatr*. 2020;20(1):504. doi:10.1186/s12887-020-02393-2
7. Burrage LC, Guillerman RP, Das S. Lung transplantation for FLNA-associated progressive lung disease *J Pediatr*. 2017;186:118-123. doi:10.1016/j.jpeds.2017.03.045
8. de Wit MCY, Tiddens HAWM, de Coo IFM. Lung disease in FLNA mutation: confirmatory report *Eur J Med Genet*. 2011;54(3):299-300. doi:10.1016/j.ejmg.2010.12.009
9. De Giorgio R, Cogliandro R, Barbara G, Corinaldesi R, Stanghellini V. Chronic intestinal pseudo-obstruction: clinical features, diagnosis and therapy. *Gastroenterol Clin North Am*. 2011;40(4):787-807. doi:10.1016/j.gtc.2011.09.005
10. Vriend I, Oegema R. Genetic causes underlying grey matter heterotopia. *Eur J Paediatr Neurol*. 2021;35:82-92. doi:10.1016/j.ejpn.2021.09.015
11. Parrini E, Ramazzotti A, Dobyns W, et al. Periventricular heterotopia: phenotypic heterogeneity and correlation with filamin A mutations. *Brain*. 2006;129(7):1892-1906. doi:10.1093/brain/awl125
12. Shelmerdine SC, Semple T, Wallis C, et al. Filamin A (FLNA) mutation-A newcomer to the childhood interstitial lung disease (ChILD) classification. *Pediatr Pulmonol*. 2017;52(10):1306-1315. doi:10.1002/ppul.23695
13. Atwal PS, Blease S, Braxton A, et al. Novel X-linked syndrome of cardiac valvulopathy, keloid scarring, and reduced joint mobility due to filamin A substitution G1576R. *Am J Med Genet A*. 2016;170(4):891-895. doi:10.1002/ajmg.a.37491
14. Valentin V, Bervar JF, Vincent-Delorme C, et al. Filamin A mutations: a new cause of unexplained emphysema in adults? *Chest*. 2021;159(3):131-135. doi:10.1016/j.chest.2020.10.003
15. Stefanova M, Meinecke P, Gal A, Bolz H. A novel 9 bp deletion in the filamin a gene causes an otopalatodigital-spectrum disorder with a variable, intermediate phenotype. *Am J Med Genet A*. 2005;132(4):386-390. doi:10.1002/ajmg.a.30484
16. Meliota G, Vairo U, Ficarella R, Milella L, Faienza MF, D'Amato G. Cardiovascular, brain, and lung involvement in a newborn with a novel FLNA mutation: a case report and literature review. *Adv Neonatal Care*. 2022;22(2):125-131. doi:10.1097/ANC.0000000000000878
17. Fedak PW, Verma S, David TE, Leask RL, Weisel RD, Butany J. Clinical and pathophysiological implications of a bicuspid aortic valve. *Circulation*. 2002;106(8):900-904. doi:10.1161/01.cir.0000027905.26586.e8
18. Iqbal NS, Jascur TA, Harrison SM, et al. Prune belly syndrome in surviving males can be caused by Hemizygous missense mutations in the X-linked filamin A gene. *BMC Med Genet*. 2020;21(1):38. doi:10.1186/s12881-020-0973-x
19. Pardoe HR, Mandelstam SA, Hiess RK, Kuzniecky RI, Jackson GD. Alzheimer's disease neuroimaging initiative; epilepsy phenome/genome project investigators. Quantitative assessment of corpus callosum morphology in periventricular nodular heterotopia. *Epilepsy Res*. 2015;109:40-47. doi:10.1016/j.eplepsyres.2014.10.01