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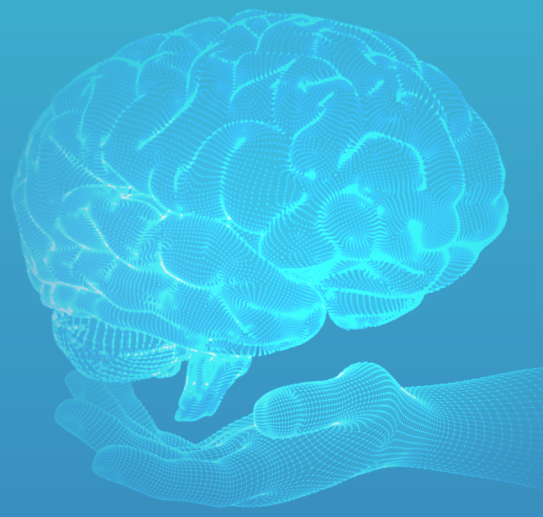

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CONTENTS

Research Articles

1 **Elder Abuse: What Should Radiologists Be Aware of?**
Oğuzhan Tokur; Kütahya, Turkey

5 **Evaluation of Fractures in the Upper Cervical Vertebrae and Concurrent Blunt Vascular Injuries to the Brain**
Çağrı Özcan, Ömer Kazcı; Ankara, Turkey

9 **Traumatic Brain Injury: CT Imaging and Cost-effectiveness**
Ahsen Geçen, Fatma Dilek Gökharman; Ankara, Turkey

13 **Relationship Between Mesenteric Lymphadenitis and SIRS**
Eren Tobcu, Zeynep Tobcu; Bursa, Turkey

Case Report

17 **Bizarre Parosteal Osteochondromatous Proliferation of the Humerus with Radiological Findings: A Case Report**
Kemal Buğra Memiş, Esra Bilici; Ankara, Erzurum, Turkey

RESEARCH ARTICLE

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Elder Abuse: What Should Radiologists Be Aware of?

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Abstract

Objectives: Imaging findings of child abuse were mostly determined through these studies. There are very few studies on elderly abuse in the literature. The aim of this study was to determine the radiologic imaging features of the consequences of abuse in elderly patients admitted to our hospital and to increase the awareness of radiologists.

Methods: Forty-six patients presented to our hospital's emergency department with a complaint of physical injury and were retrospectively diagnosed with elder abuse in a 5-year period. The diagnosis of elder abuse was confirmed by integrating clinical follow-up, history, and other patient parameters, including imaging. The patients were retrospectively evaluated in terms of age, gender, reason for hospitalization, location of the bone fracture, and fracture characteristics (side, type, and location in the bone).

Results: A total of 46 patients (21 female, 25 male) were included in the study. Hypertension (40 patients, 86.9%) was the most common accompanying chronic disease. Falling was the most common reason for admission; there were 35 patients (76.1%). All included patients had fractures. These most frequently occurred in the upper extremity (18 patients, 39.1%), head and neck fractures (14 patients, 30.4%), and chest fractures (12 patients, 26.1%). Long bone fractures were mostly distal and diaphyseal (60.9%). Two patients died, one was female and the other was male (4.3%).

Conclusion: In conclusion, it should be noted that radiological signs of elder abuse exist. All patients examined in our study had bone fractures. The most common injury was in the upper extremity. Long bone fractures were distal and diaphyseal.

Keywords: Elder abuse, physical abuse, aged, elderly, assessment tools, independent medical evaluation, diagnosis, awareness

Introduction

Elder abuse has severe physical and psychological effects but is often hidden. Screening tools can help detect and prevent harm.[1]

Although it has a much older history, elder abuse was first described in medical literature in the 1970s. Many early attempts to define the clinical spectrum of this condition and develop effective intervention strategies were limited until recently. However, the last two decades have seen advances in research on elder abuse.[2]

Elder abuse is not a new phenomenon but has been a topic of constant interest and concern in recent years. A definition used worldwide has been developed by the World Health Organization since 1995: "Elder abuse is a single or repeated act or lack of appropriate action, occurring in any relationship in which there is an expectation of trust, which causes harm or hardship to the older person".[1,3]

In addition, elder abuse although it may increase comorbidities, is generally not noticed, and it increases the risk of disease and death in old age.[2]

People usually commit abuse close to the elderly person, such as relatives or caregivers, and it is often performed physically, sexually, psychologically, or economically.[4] Unfortunately, this abuse is a community health concern, and it is considered a widespread and growing social problem all over the world.[4,5]

Dong[6] the prevalence of elder abuse among cognitively intact older adults in North and South America was approximately 10%. This rate varies widely and rises to 47.3% in older adults with dementia. The general incidence is between 3% and 18.5%, depending on the research method. Although the rate of reported elder abuse is significant, the number of unidentified, unreported elder abuse cases is believed to be much higher, according to the "iceberg" theory.[7]

Since doctors and nurses are the first people that victims of abuse may encounter, they are in a position to know these cases best and play a significant role in detecting, reporting, and preventing elder abuse. However, the reporting level of these cases is much lower than the actual incidence.[7] Reporting of abuse does not exceed 2% of cases due to reasons such as the victim's fear of reprisal and expulsion from home, the desire to protect the perpetrator, and in some cases, the elderly person with dementia does not remember it.[8]

Radiologists who evaluate pediatric patients play a critical role in detecting child abuse. When the radiologist evaluates the image in detail, he often suspects abuse even before the pediatrician. However, radiologists do not currently have this role in elder abuse cases.[9] In a

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patient suspected of being a victim of elder abuse, diagnosis may be facilitated by collaboration between the clinician and the radiologist.[10]

Limitations to the diagnostic role of radiologists include a lack of knowledge and a paucity of systematic studies on the distinctive imaging findings of physical abuse in the elderly. The lack of a clear characterization due to under-disclosure by victims and under-recognition by physicians increases the need for more objective and systematic detection of physical elder abuse, especially as the population ages and the number of cases continues to increase. Given that 24% of emergency department visits are made by the elderly patient population and that most patients undergo imaging studies during these visits, diagnostic imaging has exciting potential to provide the necessary objectivity and support for the detection of physical elder abuse.[11]

There are many studies on child abuse in the literature. Imaging findings of child abuse were mostly determined through these studies. There are very few studies on elderly abuse in the literature. The aim of this study was to determine the radiologic imaging features of the consequences of abuse in elderly patients admitted to our hospital and to increase the awareness of radiologists.

Methods

Ethical approval was obtained from the Ankara Training and Research Hospital (KAEK-2021-11-08.0014987.03) Local Ethics Committee for this study, and the Helsinki principles were followed.

Patient Selection and Radiological Evaluation: Our study is a retrospective review of 46 patients who presented to our hospital's emergency department with a complaint of physical injury and were diagnosed with elder abuse over 5 years.

The diagnosis of elder abuse was confirmed by integrating clinical follow-up, history, and other patient parameters, including imaging. There was no use of judicial authority records.

The inclusion criteria for the studies were those who were diagnosed with elder abuse following subsequent examinations and those who applied to the emergency department with a complaint of physical injury. Elderly patients who were suspected of elder abuse but not confirmed or who were injured after another trauma were excluded.

The patients were retrospectively evaluated in terms of age, gender, reason for hospitalization, location of the bone fracture, and fracture characteristics (side, type, and location in the bone).

In our hospital, all patients underwent computed tomography (CT) examinations containing bone and soft tissue windows using 16-slice and 128-slice CT scanners for the area with complaints. Imaging was performed in the supine position, and scanning was performed in the craniocaudal direction with and without iodine contrast injection. The slice thickness was 1 mm. Image reconstruction was performed in the axial, coronal, and sagittal planes.

Statistical Analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS) (IBM SPSS 22.0, IBM Corporation®, Armonk, NY, USA). The normal distribution of the data was evaluated using the Kolmogorov-Smirnov test. Descriptive statistics were obtained. The Mann-Whitney U test was used for comparisons between groups. A p value <0.05 was considered significant.

Results

The study included 46 patients. The mean age of 46 patients included in the final analysis was 76.7±2.3 years. Twenty-five (54.3%) of the patients were male and 21 (45.7%) were female.

There were accompanying comorbid diseases in 44 (95.6%) patients. Hypertension is the most common chronic disease (40 patients, 86.9%). Other chronic diseases were osteoporosis in 36 patients (81.8%), coronary artery disease in 34 patients (73.9%), diabetes mellitus in 25 patients (54.3%), and dementia in 5 patients (10.9%).

The comorbidities of the patients are shown in Table 1.

Falling was the most common reason for admission; there were 35 patients (76.1%). Six of them (13.0%) were admitted to the hospital because of a loss of consciousness. The remaining 5 patients (10.9%) presented with various types of extremity pain.

While 42 of the patients (91.3%) were exposed to physical abuse, 4 patients (8.7%) were neglected. However, 43 of the patients (93.5%) were psychologically abused, and economic abuse was present in 21 patients (45.6%). There were no cases of sexual abuse.

All included patients had fractures. There were no fractures in more than one anatomical location. When the patients' fractures were examined, it was discovered that they most frequently occurred in the upper extremity (18 patients, 39.1%), head and neck fractures (14 patients, 30.4%), and chest fractures (12 patients, 26.1%). Most patients (52.2%) had soft tissue lesions at the fracture site (Figures 1 and 2).

The number and location of trauma-related lesions detected in our study group are summarized in Table 2.

Long bone fractures were mostly distal and diaphyseal (60.9%) (Figure 1). It was also discovered that 71.7% of the patients' fractures were not displaced. 15.2% of the patients had a concurrent joint dislocation.

Twenty-four of 46 patients (52.2%) had accompanying soft tissue lesions. All of them had ecchymosis in the trauma area. Hematoma was observed in 16 patients (34.8%) and edema was observed in 12 patients (26.1%). There was an incision in 4 patients (8.7%).

The soft tissue lesions of the patients are shown in Table 2.

In our study, two patients died, one was female and the other was male (4.3%).

Discussion

Elder abuse is a public health problem that is often overlooked because it is difficult to diagnose and doctors are not familiar with it.[4,7] The lack of well-defined criteria for the diagnosis of elder abuse, as in child abuse, makes diagnosis difficult.

Table 1. Chronic disease of patients

Chronic disease	Number	Percentage (%)
Hypertension	40	86.9
Osteoporosis	36	78.3
Coronary artery disease	34	73.9
Diabetes mellitus	25	54.3
Dementia	5	10.8
Total	46	100

Table 2. Number and location of fractures and trauma-related soft tissue lesions in patients

Fracture location	Number	Percentage (%)
Upper extremity	18	39.1
Head and neck fractures	14	30.4
Chest fracture	12	26.1
Lower extremity	2	4.3
Soft tissue lesions		
Hematoma	16	34.8
Edema	12	26.1
Incision	4	8.7
Total	46	100

Figure 1. A 75-year-old female patient. A displaced spiral fracture is observed in the coronal (A, B, C, arrows) and axial computed tomography images (D, E, arrows) of the proximal diaphysis of the humerus

Because elder abusers are frequently vulnerable, they have few opportunities to discuss their abuse. This is something that emergency physicians and radiologists should always keep in mind. The effectiveness of radiologists in detecting elder abuse is lower than that of the child abuse. According to previous studies, the cause of this situation is a lack of information and a breakdown in communication with the clinician.[12]

The aim of this study was to determine the radiological imaging characteristics of the consequences that may occur due to abuse in elderly patients and to increase the awareness of radiologists.[11]

In our study, all patients had bone fractures, and the most frequently affected area was the upper extremity. There were accompanying comorbid diseases in 95.6% of the patients. Falling is the most common reason for admission. Long bone fractures were mostly distal and diaphyseal. The mean age was found to be 76.7 years, similar to studies in the literature. No significant difference was observed.[13]

According to previous studies on large series, female and male elderly patients are exposed to abuse at equal rates.[14] In our study, the male-female ratios were almost equal.

In their study, Mouton et al.[14] found that the most common comorbidities were psychiatric diseases, dementia, and heart diseases, respectively. Kavak and Özdemir,[8] similar to our study, found comorbidities to be osteoporosis, hypertension, and cardiovascular diseases.

Similar to the study by Kavak and Özdemir,[8] in our study, the most common presentation was falls, followed by loss of consciousness. The elderly are frequently affected by osteoporosis and other chronic diseases that increase their risk of falling. However, falling because of being pushed by the caregiver is considered abuse. This should also be considered when caring for the elderly.

Acierno et al.[15] showed that emotional-psychological abuse is more common than physical abuse in the elderly population. In our study, physical abuse was a priority, which may be related to our selection of patients with fractures. In addition, although there was sexual abuse in Acierno et al.'s[15] study, it was not present in our study. This situation can probably be explained by cultural reasons.

In our study, all patients had bone fractures. Several studies in the literature included patients who suffered physical injuries without bone fractures or those with bone fractures in more than one location.

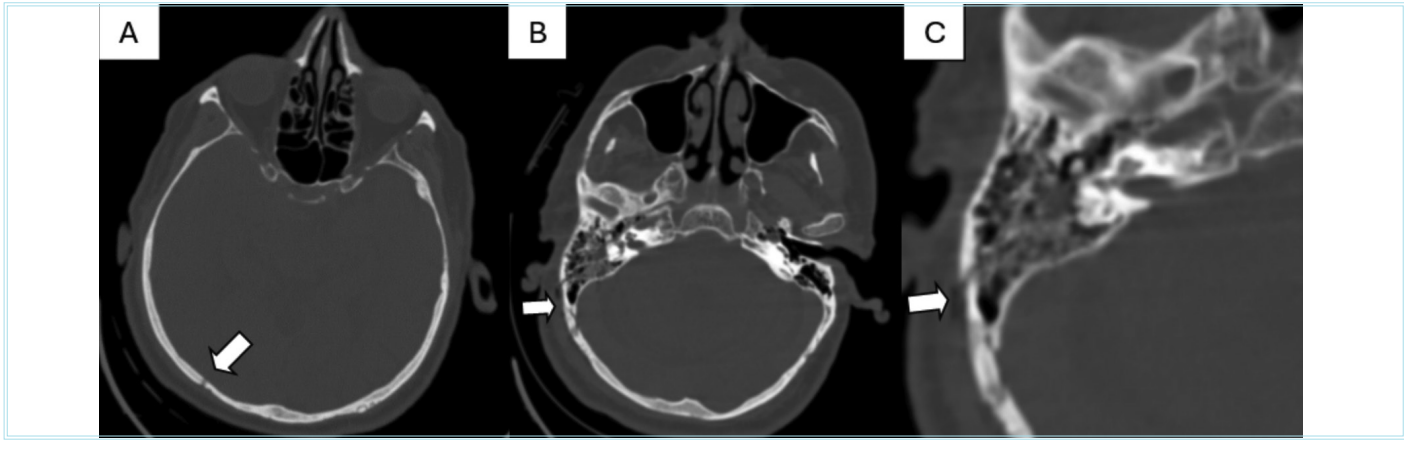

Figure 2. A 69-year-old male patient. Occipital fracture in axial computed tomography images (A, arrow) and temporal bone mastoid segment linear nondisplaced fracture in axial computed tomography images (B, C, arrows)

This is due to the heterogeneity and the different distribution of bone fractures.

Frazão et al.[16] reported that head and neck injuries, followed by upper extremity injuries, are the most common injuries in abused elderly patients. Murphy et al.[9] reported in their study that, being present in 44% of the victims, the upper extremity is the most common location subjected to trauma in the elderly who are abused. In accordance with previous data, the upper extremity and head and neck were the most frequently affected locations in our study.

In most studies, fractures were observed to be distal and diaphyseal. This could mean that it could be a warning marker for elder abuse.

The mortality rate due to elder abuse is reported to be 6-18.3%.[17] The mortality rate from trauma exposure increases over time. Nagurney et al.[18] found that the most common cause of death from elder abuse was subdural hematoma in their study. In another study, head and neck injuries in elderly patients were the most common injuries among those who died due to abuse.[19] In our study, the mortality rate was found to be 4.3%, lower than that reported in the literature. The reason for this may be that head and neck injuries are less severe.

Ziminski et al.[20] found that soft tissue lesions accompanied more than half of the patients, similar to our study.

Study Limitations

Our study has some limitations. First, as this was a retrospective study, extensive data review and detailed history taking were not possible, and because of the retrospective design, there is a slight possibility of bias in patient selection. Second, our relatively small sample size reduces the power of our results. Different results may be obtained if the number of participants is increased. Third, being a single-center study is another limitation.

Conclusion

In conclusion, it should be noted that radiological signs of elder abuse exist. All patients examined in our study had bone fractures. The most common injury was in the upper extremity. Long bone fractures were distal and diaphyseal. Our study provides direction for future research to be alert to radiological findings that may be seen in elder abuse and to assist in the diagnosis.

Ethics

Ethics Committee Approval: Ethical approval was obtained from the Ankara Training and Research Hospital Local Ethics Committee (KAEK-2021-11-08.0014987.03).

Informed Consent: Since the study was a retrospective study, informed consent was not required by the ethics committee.

Financial Disclosure: The author declared that this study received no financial support.

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RESEARCH ARTICLE

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Evaluation of Fractures in the Upper Cervical Vertebrae and Concurrent Blunt Vascular Injuries to the Brain

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Abstract

Objectives: The aim of this study was to explore the relationship between upper cervical spine fracture patterns and associated blunt cerebrovascular injuries (BCVIs), to detail the epidemiology, mechanisms, diagnostic strategies, and management approaches of these conditions, and to highlight the significance of early diagnosis and effective intervention on patient outcomes.

Methods: Patients with upper cervical spine fractures and resulting BCVI in two different centers over 10 years were retrospectively evaluated. A detailed manual review was conducted to filter out cases that involved non-acute pathological fractures or those complicated by previous surgeries, narrowing our focus to individuals with acute C1 and/or C2 fractures who underwent critical computed tomography angiography (CTA) within 24 h following their initial diagnosis. Our examination extended to the detection of BCVIs by using the comprehensive capabilities of both CTA and magnetic resonance imaging to uncover the full extent of vascular injuries secondary to spinal trauma.

Results: A total of 1,250 patients were identified with acute fractures in the C1 and/or C2 vertebrae. Of these, the distribution between C1 and C2 fractures revealed a higher incidence of C2 fractures, accounting for approximately 70% of the cases. Among the patients with C1 and/or C2 fractures, 150 were diagnosed with BCVIs. The demographic analysis revealed a higher incidence of these injuries in males, comprising 65% of the cases, and predominantly in the age group of 20-40 years. Motor vehicle accidents emerged as the leading cause of both upper cervical spine fractures and associated BCVIs, accounting for 55% of all cases. Among BCVI patients, seven patients had stroke.

Conclusion: The results of our investigation provide evidence of the significant risk of BCVIs in patients with upper cervical spine fractures, particularly in a younger, predominantly male demographic involved in high-energy trauma incidents. The findings underscore the importance of a high index of suspicion, timely diagnosis, and appropriate management strategies to improve patient outcomes and reduce the risk of serious complications like stroke.

Keywords: Fracture, cervical bone, vascular injuries, cervical spine, blunt cerebrovascular injury

Introduction

Upper cervical spine fractures and associated blunt cerebrovascular injuries (BCVI) are crucial topics in trauma medicine and require an interdisciplinary approach for optimal patient care. The upper cervical spine, which consists of the atlas (C1) and axis (C2), is fundamental in supporting the skull, facilitating head movements, and protecting vital neurovascular structures. Fractures in this region, such as atlanto-occipital dislocation, Jefferson fractures, Hangman's fractures, and odontoid process fractures, can result from high-impact trauma scenarios, including motor vehicle accidents, falls, and sports injuries.[1,2]

BCVI, which encompass a range of arterial damages from intimal tears to complete occlusions, predominantly affect the vertebral and carotid arteries. These injuries can lead to ischemic stroke, significantly deteriorating the trauma patient's prognosis.[2] The mechanism underlying BCVIs involves either direct trauma, stretch/compression due to displaced fractures, or thromboembolic events from vessel wall damage.[3]

There are studies in the literature showing that BCVI is seen in approximately 1% of all trauma patients[2-5] and is frequently associated with cervical spine injury.[1,4,6] Despite the reported prevalence of BCVI in upper cervical spine fracture cases, diagnosing these injuries remains challenging due to the diverse clinical presentations and limitations of diagnostic imaging modalities like computed tomography (CT) angiography (CTA) and magnetic resonance angiography.[7] Therefore, a high index of suspicion is essential, particularly in patients with significant trauma and specific fracture patterns indicative of high BCVI risk.[8]

The management of BCVI aims to prevent secondary neurological complications, with treatment options ranging from antithrombotic therapy to invasive procedures such as endovascular stenting or surgical repair, depending on the injury's severity and location.[9,10] Concurrently, managing upper cervical spine fractures requires a tailored approach that combines surgical and nonsurgical interventions to stabilize the spine, preserve neurological function, and prevent disability.[11]

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In summary, upper cervical spine fractures and BCVI represent a significant concern in trauma medicine, necessitating a multidisciplinary strategy for effective management. Ongoing research is vital to improve diagnostic accuracy, refine imaging techniques, and develop advanced treatment methodologies, ultimately enhancing patient outcomes in this complex injury domain.[12]

The aim of this study was to explore the relationship between upper cervical spine fracture patterns and associated BCVIs, to detail the epidemiology, mechanisms, diagnostic strategies, and management approaches of these conditions, and to highlight the significance of early diagnosis and effective intervention on patient outcomes.

Methods

Patients with upper cervical spine fractures and resulting BCVI in two different centers over 10 years were retrospectively evaluated. Ethics committee approval was obtained from Bilkent City Hospital (2022-08/123.11) for this study, and the Helsinki principles were adhered to during the study. Because of the retrospective design of the study, no additional informed consent form was obtained from the patients.

Our investigative journey embarked on an extensive review of adult patients who experienced cervical spine traumas, as recorded in their emergency admissions across these two venerated institutions over an eight-year period. Employing a sophisticated blend of machine learning and Natural Language Processing technologies, the study combed spine CT scan. This advanced screening process was aimed at identifying fractures. Following this, a detailed manual review was conducted to filter out cases that involved non-acute, pathological fractures or those complicated by previous surgeries, narrowing our focus to individuals with acute C1 and/or C2 fractures who underwent a critical CTA within 24 h following their initial diagnosis (Figure 1).

This study embarked on an exhaustive collection of data, encompassing a wide array of variables from patient demographics to the nuanced specifics of the fractures themselves-covering fracture level, site, and morphology. Beyond the superficial data, our examination extended to the detection of BCVIs, using the comprehensive capabilities of both CTA and magnetic resonance imaging to uncover the full extent of vascular injuries secondary to spinal trauma. The approach to managing these cases was also closely examined, ranging from conservative strategies such as collar immobilization to more aggressive interventions, including pharmacological therapies and surgical or endovascular procedures.

Statistical Analysis

Our analytical exploration was designed to unravel the complex relationship between the structural details of spinal fractures and the occurrence of BCVIs or cerebrovascular events. Through the application of statistical methodologies such as the Student's t-test for continuous variables and Fisher's exact test or chi-square analysis for categorical data, this study aimed to shed light on the dynamics of traumatic injuries and their clinical implications. Statistical analysis of the data was performed using the Statistical Package for the Social Sciences (SPSS), version 11.0 (SPSS, Inc., Chicago, IL, USA). A p value of <0.05 was considered statistically significant.

Results

Following a review of 21,000 cervical spine CT scans at both centers, our study revealed significant findings that shed light on the complex relationship between upper cervical spine fractures and BCVIs.

A total of 1,250 patients were identified with acute fractures in the C1 and/or C2 vertebrae. Of these, the distribution between C1 and C2 fractures revealed a higher incidence of C2 fractures, accounting for approximately 70% of the cases (850 patients). This suggests a predilection for C2 involvement in upper cervical spine traumas in our study population. Among the patients with C1 and/or C2 fractures, 150 patients (0.7%) were diagnosed with BCVIs. The demographic analysis revealed a higher incidence of these injuries in males, comprising 65% of the cases (812 patients), and predominantly in the age group of 20-40 years.

Motor vehicle accidents emerged as the leading cause of both upper cervical spine fractures and associated BCVIs, accounting for 55% of the

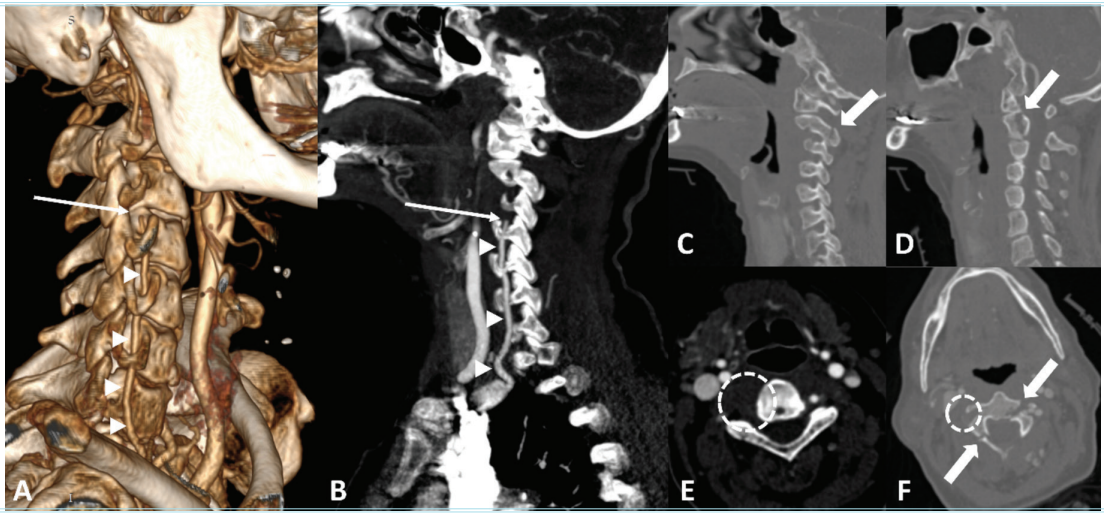

Figure 1. Sixty-five year-old female patient, upper cervical vertebra fracture and concurrent blunt vertebral artery injury. A) Three-dimensional volume rendering of computed tomography (CT) angiography (CTA) and B) 3D MIP image in sagittal view showing a sudden interruption in the right vertebral artery due to injury (thin arrows). C, D) CT sagittal bone reformat images show the extension of C2 vertebra fractures (thick arrows). E-F Axial section image of CTA showing no contrast filling in the right vertebral artery (circle) in subsequent sections after the injury. F) Axial bone reformatting image of CT showing the extension of fractures in C2 vertebra (thick arrows) and absence of contrast filling in the right vertebral artery (circle)

cases (687 patients). This was followed by falls from a height, underscoring the impact of high-energy trauma as a primary mechanism.

Management strategies varied, with conservative measures like collar immobilization being the initial approach for uncomplicated fractures. However, in patients with BCVIs, a more aggressive treatment protocol was adopted, including antiplatelet or antithrombotic therapy, and in severe cases, surgical or endovascular interventions. The tailored approach to management, based on the severity and complexity of the injury, resulted in positive outcomes in 80% of the cases.

The study also noted a 5% (7 patients) incidence of stroke in patients with BCVIs, emphasizing the severe potential complications of these injuries. This finding further supports the need for comprehensive care and aggressive management to mitigate the risk of adverse outcomes.

Discussion

The examination of over 21,000 cervical CT scans from two centers over a 10-year period provides a comprehensive overview of the prevalence and outcomes of upper cervical spine fractures and associated BCVIs. This study's findings contribute significantly to the existing literature, emphasizing the intricate relationship between cervical spine fractures, particularly at the C1 and C2 levels, and the subsequent risk of BCVIs.

Our study's emphasis on the prevalence of C2 fractures aligns with previous research indicating the axis's susceptibility due to its pivotal role in cervical spine mobility and load-bearing.[2] Such findings mirror those presented by Passias et al.,[13] who noted the biomechanical and clinical significance of C2 fractures in spinal trauma. The demographic trend observed, predominantly affecting males aged 20-40 years, corroborates the epidemiological patterns highlighted by Holly et al.[14] underscoring the impact of gender and age on trauma incidence.

The significant association between upper cervical spine fractures and BCVIs identified in our cohort reinforces the need for vigilance in screening and early diagnosis, as emphasized by Gelb et al.[15] their work on the necessity for aggressive screening protocols in patients with cervical spine injuries to prevent catastrophic cerebrovascular complications provides a crucial context for interpreting our findings. Furthermore, the mechanism of injury, predominantly stemming from high-energy impacts such as motor vehicle accidents, aligns with the risk factors identified by Malhotra et al.,[8] stressing the need for targeted preventive strategies in this demographic.

The diverse management strategies observed in our study, from conservative approaches to aggressive interventions for BCVI, underscore the importance of a personalized treatment plan. This approach is supported using the guidelines proposed by Gelb et al.,[15] who discussed the nuanced decision-making process in managing cervical spine fractures and associated vascular injuries. The 5% incidence of stroke among patients with BCVIs in our study highlights the severe consequences of these injuries and echoes the findings of Scott et al.,[16] who analyzed the outcomes of carotid artery injuries, emphasizing the critical nature of early detection and intervention.

Among the patients with C1 and/or C2 fractures, 150 patients (0.7%) were diagnosed with BCVIs. This represents a notable correlation, highlighting the vulnerability of cerebrovascular structures to trauma in cases of upper cervical spine fractures. The BCVI occurrence rate in our cohort underscores the critical need for vigilant assessment and diagnostic strategies to identify vascular injuries early. Demographic analysis revealed a higher incidence of these injuries in males. This demographic trend aligns with the active lifestyle and higher risk behaviors associated with this population segment. The study also noted stroke in patients with BCVIs, emphasizing the severe potential complications of these injuries. This finding further supports the need for comprehensive care and aggressive management to mitigate the risk of adverse outcomes. The results of our investigation provide evidence of the significant risk of BCVIs in patients with upper cervical spine fractures, particularly in a younger, predominantly male demographic involved in high-energy trauma incidents. The findings underscore the importance of a high index of suspicion, timely diagnosis, and appropriate management strategies to improve patient outcomes and reduce the risk of serious complications like stroke. This study contributes valuable insights into the epidemiology, mechanisms, and effective management of these complex injuries, reinforcing the need for continued research and education in this critical area of trauma care.

Study Limitations

The most important limitation was that the study had a retrospective design. In addition, the possibility of bias in patient selection, albeit with low probability, is one of the limitations of the study.

While our study sheds light on the complex interplay between upper cervical spine fractures and BCVIs, it also underscores the need for further research. Future investigations should focus on refining diagnostic criteria and exploring new therapeutic interventions, diagnostic challenges, and treatment options for BCVI. Prospective research could build on our findings by leveraging advanced imaging technologies and exploring genetic predispositions to better understand the mechanisms underlying these injuries and improve patient outcomes.

Conclusion

In conclusion, this extensive analysis underscores the critical need for heightened awareness, early diagnostic screening, and tailored management strategies for patients presenting with upper cervical spine fractures, given the associated risk of BCVIs. By drawing on a robust dataset and integrating our findings with the existing literature, we contribute to the ongoing effort to enhance trauma care and patient safety.

Ethics

Ethics Committee Approval: Ethics committee approval was obtained from Bilkent City Hospital (2022-08/123.11)

Informed Consent: Since the study was a retrospective study, informed consent was not required by the ethics committee.

Authorship Contributions

Surgical and Medical Practices - Concept - Design - Data Collection or Processing - Analysis or Interpretation - Literature Search - Writing: Ç.Ö., Ö.K.

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RESEARCH ARTICLE

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Traumatic Brain Injury: CT Imaging and Cost-effectiveness

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Abstract

Objectives: The purpose of this study was to classify patients presenting to the emergency department with head trauma according to the Canadian Head CT Rule (CCHR) to determine the number of unnecessary computed tomography (CT) scans performed and to assess the radiation exposure and cost of unnecessary CT scans.

Methods: This single-center retrospective cohort study included patients older than 15 years with a head injury and a Glasgow Coma Scale (GCS) score of 13-15. A retrospective chart review collected demographic, clinical, radiographic, and hospital course variables. The patient files were reviewed and scored according to CCHR, unbeknownst to other researchers. The study population consisted of 150 patients. The criterion of "minor head injury" used to develop the CCHR guideline comprised "a history of loss of consciousness, amnesia, or confusion, as well as a GCS score of at least 13-15.

Results: This study included a final sample of 150 patients (85/150 men; mean age 52.0±23.9 years). All patients presented with trauma. Ten (6.6%) patients presented with GCS 13 and 39 (26.0%) patients presented with GCS 14. Two (1.3%) patients presented with suspected open or depressed skull fracture. Sixty-five (43.3%) CTs were performed in accordance with CCHR. Sixty-three (42.0%) CTs showed pathology. Two (1.3%) CTs showed no pathology. Eighty-five (56.7%) CTs were not performed in accordance with CCHR. Sixty-eight (45.3%) of these CTs showed no pathology and 17 (11.3%) CTs showed pathology.

Conclusion: We demonstrated that unneeded CTs result in wasteful radiation doses and costs. CCHR is an excellent indicator of which type of mild head trauma requires CT. In our study, approximately 57% of CTs were unnecessary and 80% of unnecessary CTs did not show pathology. In this study, the total unnecessary radiation dose was 2940 mSv, and the total unnecessary cost was 466.9 dollars.

Keywords: Traumatic brain injury, emergency medical services, tomography, unnecessary CTs, radiation exposure, cost-effectiveness analysis

Introduction

Traumatic brain injury (TBI) is a major public health concern around the world.[1] Because of the incidence of TBI, brain computed tomography (CT) scans are required. Unnecessary CT affects the economy by raising costs[1] and causes the dose to be loaded incorrectly. The New Orleans Criteria (NOC)[1,2] and the Canadian Head CT Rule (CCHR)[3] are two criteria that determine who should be diagnosed with TBI. Other criteria are the National Emergency X-Radiography use Study[4,5] and the ACR Appropriateness Criteria for Head Trauma.[6]

When compared with clinical judgment without a decision-making tool, these tools have higher sensitivity and specificity in detecting the need for neurological intervention and clinically important brain injury in emergency department patients with minor head injuries [Glasgow Coma Scale (GCS) of 15 for NOC and 13-15 for CCHR]. They result in a greater positive detection rate overall.[2,7-9]

When compared with the head trauma criteria, the CCHR contains fewer variables and more objective elements as a clinical decision-making tool. We chose CCHR to measure intracranial injury in our study population because of its high sensitivity and high spesifity.[2] The CCHR requires high risk for neurosurgical intervention GCS <15 at 2 h after injury, suspected open or depressed skull fracture, any sign of basal skull fracture, 2 or more episodes of vomiting, age 65 or older; medium risk of brain injury detection by CT, amnesia before impact of 30 min or more dangerous mechanism.[2]

In one study, brain CT characteristics were studied in elderly patients seeking emergency care according to the CCHR for minor trauma.[10] Another study was conducted in a single-centered cohort study in Ethiopia, which examined the characteristics of patients who applied for emergency service head injury compared with CCHR and NOC.[1] Studies have been conducted on the suitability of CT for people applying for head injuries to emergency services, but the results are limited. There are only a few studies on this topic, and the population is small.

In our study, we aimed to learn about the unnecessary number of CTs taken by classifying patients over 15 years of age who apply for emergency head injuries according to CCHR and aimed to identify the radiation load and cost of unnecessary CTs.

Methods

This study was conducted in accordance with the principles of the Declaration of Helsinki. Ethical approval and permission to participate in this study were obtained from Ankara Training and Research Hospital Research Committee (KAEK-2023-01/12.320578).

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This study is a single-center retrospective cohort study conducted over 3 years.

This single-center retrospective cohort study included patients older than 15 years with a head injury and a GCS score of 13-15. A retrospective chart review collected demographic, clinical, radiographic, and hospital course variables.

The search and inclusion criteria were subjects undergoing traumatic cranial CT requested who were older than 15 years of age by the emergency department.

Individuals under 15 years of age, a history of head injury in the month prior to emergency department, known brain tumor (primary or metastatic), known hydrocephalus with ventricular shunting, intracranial hemorrhage or ischemia in the month before emergency department presentation, and those with motion and beam hardening artifacts were excluded from the study.

A total of 196 patients were evaluated in the study. Twenty-four patients aged 15 and under 15 years, 3 patients with a history of head injury in the month prior to emergency department, 5 patients with known brain tumor (primary or metastatic), 4 patients with known hydrocephalus with ventricular shunting, or 7 patients with intracranial hemorrhage or ischemia in the month before emergency department presentation, and 3 patients with motion and beam hardening artifacts were excluded. Finally, the study population consisted of 150 patients.

We included patients who underwent brain CT with and without intravenous contrast as requested by the emergency department of our institution.

Participants were selected using our image archiving system.

All patients in our hospital underwent brain CT examinations using 16-slice and 128-slice CT scanners. CT was examined using a third-generation device (Somatom Go Top, Siemens Healthineers, Erlangen, Germany). Intravenous administration of 50-60 mL iohexol (rate=4.0 mL/sec) through the antecubital vein was followed by a 40-mL saline bolus. Following the acquisition of scouts, imaging was performed in the supine position, scanning in the craniocaudal direction with the following parameters: 80/120 kVp, 60 mAs, and rotation time 0.33 s. The slice thickness was 1 mm. Image reconstruction was performed in the axial, coronal, and sagittal planes.

Radiology professionals with 1 and 11 years of experience evaluated the CTs separately and decided by consensus whether there was pathology in the CTs with discordant results.

The CCHR was established to assist clinicians in determining which patients with head injuries require head CT imaging.[4] CCHR is a highly sensitive tool that identifies five high-risk factors ("failure to reach a GCS score of 15 within 2 hours, suspected open skull fracture, any sign of basal skull fracture, vomiting ≥2 episodes, or age ≥65 years") and two medium-risk factors ("amnesia before impact >30 min and dangerous mechanism of injury"). The criterion of "minor head injury" used to develop this guideline comprised "a history of loss of consciousness, amnesia, or confusion, as well as a GCS score of at least 13-15".[10] CCHR is described in Table 1.

A different radiologist with 2 years of experience reviewed the patient files and scored them according to CCHR, unbeknown to other researchers. Patients' demographic characteristics, age, sex, etc. were collected retrospectively.

Statistical Analysis

Data were analyzed using IBM SPSS Inc.'s Statistical Package for Social Sciences (SPSS) for Windows 20 software. The Kolmogorov-Smirnov test was used to determine whether the data matched a normal distribution. Numerical variables with a normal distribution are represented as mean±standard deviation, and categorical variables as number (n) and percentage.

Results

This study included a final sample of 150 patients (85/150 men; mean age 52.0±23.9 years). Thirty-five (23.3%) patients were younger than 40 years. Seventy-four (49.3%) were 65 years and older.

The electronic request and emergency department discharge summary were reported on the same day in all cases. All cases were non-contrast CT scans because no contrast CT scan was performed between admissions.

All patients presented with trauma. Ten (6.6%) patients presented with GCS 13 and 39 (26.0%) patients presented with GCS 14 at least 2 h after trauma. Others (67.3%) presented with GCS 15.

Two (1.3%) patients presented with suspected open or depressed skull fracture. None of the patients presented with racoon eyes, hemotympanum, otorrhea/rhinorrhea, or Battle's sign. The number of people admitted with 2 or more episodes of vomiting was 9 (6.0%). The number of people admitted with pedestrian struck by vehicle is 13 (8.7%). The number of people admitted with an occupant ejected from a motor vehicle is 18 (12.0%). The number of people admitted with fall from an elevation of 1 m or 5 stairs more is 23 (15.3%). The number of people admitted with others is 85 (56.7%). Examples of cases in our clinic are shown in Figure 1.

The 3 most common reasons for admission are others is, fall from elevation of 1 meter or 5 stairs more 23 (15.3%) patients, occupant ejected from motor vehicle 21 (14.0%) patients, The rarest reason for admission is suspected open or depressed skull fracture 3 (2.0%) patients. Other reasons are shown in Table 2.

Sixty-five (43.3%) CTs were performed in accordance with CCHR. Sixty-three (42.0%) CTs showed pathology. Two CTs showed no pathology. Eighty-five (56.7%) CTs were performed not in accordance with CCHR.

Table 1. Canadian head computed tomography rule

High risk of neurosurgical intervention:
Glasgow Coma Scale <15 in 2 h after injury
Suspected open or depressed skull fracture
Sign of basal skull fracture*
Two or more episodes of vomiting
Age 65 years or older
Medium risk of brain injury detection by computed tomography:
Amnesia before impact of 30 min more
Dangerous mechanism**
***Signs of basal skull fracture**
Hemotympanum, "racoon" eyes, cerebrospinal fluid otorrhea/rhinorrhea, Battle's sign
****Dangerous mechanism**
Pedestrian struck by vehicle
Occupant ejected from the motor vehicle
Fall from elevation of 1 meter or 5 stairs more

Sixty-eight of these CTs showed no pathology and 17 CTs showed pathology. The classification of CT scans is shown in Tables 3 and 4.

A brain CT scan contains a radiation dose of 42 milliSieverts (mSv). The cost of a brain CT scan is $6.67. According to the CCHR, there are 70 CT scans with discordant results that are unnecessary. This corresponds to a total unnecessary radiation dose of 2940 mSv. The total unnecessary cost is $466.9 dollars.

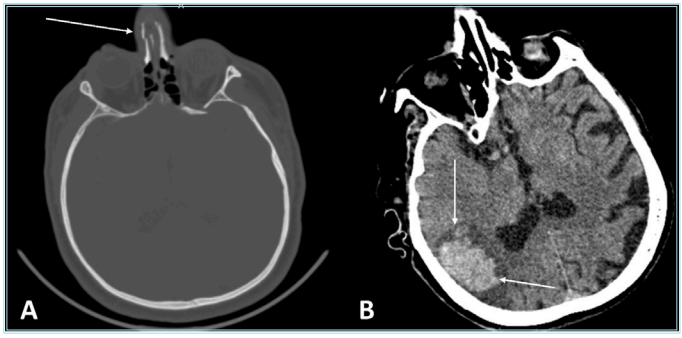

Figure 1. Nasal fracture and intraparenchymal hemorrhage. A) The image on the left is an axial CT scan of a patient admitted to our hospital with beatings and punishments. The image shows a nasal fracture (arrow). B) The image on the right is a CT scan of a patient admitted with the occupant ejected from the motor vehicle. The image shows intraparenchymal hemorrhage (arrows) and edema

CT: Computed tomography

Table 2. The number of people admitted for other reasons

Reason	Number (%)
Fall from height less than 1 m	26 (17.3)
Beatings and punishments	37 (24.7)
Hitting your head against a hard object at a slow speed	22 (14.7)

Table 3. Pathology rates

CTs	Number of people with pathology	Number of people without pathology
CCHR-eligible shots	63	2
Shootings not in accordance with the CCHR	17	68

CT: Computed tomography, CCHR: Canadian Head CT Rule

Table 4. Pathologies of CTs

Pathologies	Number	
	CCHR: Eligible shots	Shootings not in accordance with the CCHR
Subarachnoid hemorrhage	7	1
Subdural hematoma	13	4
Epidural hematoma	9	2
Le-Fort fracture	3	
Aneurysm rupture	1	
Nasal fracture	5	10
Blow out fracture	8	
Contusion: Intraparenchymal hemorrhage	14	
Pneumocephaly	1	
Coup-contra coup lesion	2	

CT: Computed tomography, CCHR: Canadian Head CT Rule

Discussion

In this study, we hope to learn about the needless number of CTs performed by categorizing patients over the age of 15 who apply for emergency head injuries based on CCHR and determining the radiation burden and cost of unneeded CTs. We demonstrated that unneeded CTs result in wasteful radiation doses and costs. CCHR is an excellent indicator of which type of mild head trauma requires CT.

There is an increasing use of CT in emergency departments in daily practice because of reasons such as increased patient density, fear of malpractise and the desire to reach a diagnosis quickly. As a result, there is an exponential increase in patients' radiation exposure. There are many studies in the literature showing that there is an increasing use of CT in studies on this subject.[3,11] In addition to radiation exposure, unnecessary CT examination may cause an increase in the time the patient spends in the hospital, unnecessary costs, and side effects due to the iodinated contrast material used.[12-14] It is known that most patients with minor head trauma who frequently visit emergency departments receive CT scans in emergency departments.[15]

The CCHR was created in 2001 as a guideline to help clinicians determine which patients with minor head traumas should receive head CTs. The CCHR is a clinical decision-making tool designed to assist emergency physicians in ordering appropriate head CTs for adult patients with minor head traumas. The CCHR has been proven to be the most effective clinical decision rule for limiting testing and preventing missed injuries in people with mild head injuries. Żyluk's[16] 2015 comprehensive review found that the CCHR has 100% sensitivity and 48-77% specificity. CCHR has been verified in hospitals worldwide. Despite the adoption of the CCHR in hospital systems, research has revealed that it is not regularly followed in practice.[17]

Studies have shown that unnecessary CTs cause cost and radiation burden.

Karavas et al.[18] in their study, inadvertent exposure to high amounts of ionizing radiation can cause short-term damage such as burns and hair loss. Exposure to such dosages directly in the eyes increases the chance of cataracts. Fatihoglu et al.[19] In their study, younger patients undergoing CT were more vulnerable to the potential neoplastic effects of ionizing radiation. Gökharman et al.[20] In their study, calculated the cost of unnecessary CTs performed in the emergency department.

Study Limitations

Our study has some limitations, such as the low number of participants and the fact that it is a single-center and retrospective study.

Conclusion

In conclusion, in our study, approximately 57% of CTs were unnecessary and 80% of unnecessary CTs did not show pathology. The total unnecessary radiation dose was 2940 mSv. The total unnecessary cost is $466.9 dollars. We demonstrated that unneeded CTs result in wasteful radiation doses and costs, and CCHR is an excellent indicator of which type of mild head trauma requires CT.

Ethics

Ethics Committee Approval: Ethical approval was obtained from Ankara Training and Research Hospital Research Committee (KAEK-2023-01/12.320578).

Informed Consent: Since the study was a retrospective study, informed consent was not required by the ethics committee.

Authorship Contributions

Surgical and Medical Practices - Concept - Design - Data Collection or Processing - Analysis or Interpretation - Literature Search - Writing: A.G., F.D.G.

Conflict of Interest: No conflict of interest was declared by the authors.

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RESEARCH ARTICLE

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Relationship Between Mesenteric Lymphadenitis and SIRS

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Abstract

Objectives: Mesenteric lymphadenitis is a condition characterized by inflammation of the lymph nodes in the mesentery. Systemic inflammatory response syndrome (SIRS) is a clinical response to a non-specific insult, which can be caused by various factors such as infection, trauma, burns, or other severe bodily stresses. The study aims to investigate the relationship between mesenteric lymphadenitis and SIRS, hospitalization, and treatment.

Methods: This single-center retrospective cohort study was conducted. A total of 58 patients who presented to the emergency department with acute abdominal pain and were diagnosed with mesenteric lymphadenitis on computed tomography were evaluated.

Results: A total of 58 patients (27 males and 31 females) with mesenteric lymph adenitis were included in the study. Fever of 37.5 °C and above was recorded in 5 patients (8.6%). Fourteen patients (24.1%) had leucocytosis. Twenty-four patients (41.4%) had elevated CRP. The mean CRP in this group was 15.2±14.1 mg/L. Tachycardia was detected in four patients (6.9%). Tachypnoea was recorded in 3 patients (5.2%). In our study, 12 patients (20.7%) fulfilled SIRS criteria. The most frequently met SIRS criteria in these mesenteric lymphadenitis patients were fever (n=5), white cell count (n=14), heart rate (n=4) and respiratory rate (n=3). In our study, the hospitalisation rate tended to be higher in the SIRS group (4/12 patients) compared to the non-SIRS group (1/46 patients).

Conclusion: The rate of SIRS (+) was lower in patients diagnosed with mesenteric lymphadenitis. The group with SIRS (+) was more likely to accompany additional radiological comorbidity and hospitalization rates. The group with SIRS (+) was more likely to accompany additional radiological comorbidity and hospitalization rates.

Keywords: SIRS, mesenteric lymphadenitis, emergency radiology, fever

Introduction

Mesenteric lymphadenitis is characterized by inflammation of the lymph nodes in the mesentery. This condition typically presents with symptoms such as abdominal pain, fever, and gastrointestinal problems. Mesenteric lymphadenitis is usually caused by bacterial or viral infections and is more common in children and young adults. Diagnosis is typically made through a physical examination, blood tests, and imaging studies such as ultrasound or computed tomography (CT) scans to rule out other causes of abdominal pain. Once diagnosed, mesenteric lymphadenitis is usually treated with rest, painkillers, and antibiotics if there is evidence of bacterial infection.[1,2]

Systemic inflammatory response syndrome (SIRS) is a clinical response to a nonspecific insult that can be caused by various factors such as infection, trauma, burns, or other severe bodily stresses. It is characterized by a widespread inflammatory response that can lead to organ dysfunction and failure if not manage promptly and effectively.[3-5]

While it is important to consider the potential relationship between mesenteric lymphadenitis and SIRS, it is also crucial to acknowledge that not all cases of mesenteric lymphadenitis lead to SIRS. Mesenteric lymphadenitis is primarily a localized inflammatory condition, and its progression to SIRS depends on various factors such as the severity of the infection and the individual's overall health status. Furthermore, studies have shown that the incidence of SIRS in patients with mesenteric lymphadenitis is low compared with that in patients with other systemic inflammatory conditions.[6] However, numerically indicating the frequency of SIRS occurrence in patients with mesenteric lymphadenitis is not straightforward because of the variability in patient populations, diagnostic criteria, and reporting standards. Typically, mesenteric lymphadenitis is considered less severe than conditions leading to SIRS and often resolves without progressing to a more systemic inflammatory state. The inflammatory response in mesenteric lymphadenitis tends to be contained within the abdominal area and may not always meet the criteria for a systemic inflammatory response.[1,2]

It is essential to approach the potential connection between mesenteric lymphadenitis and SIRS from a balanced perspective, considering the variability in individual responses and the specific causative factors involved in each case. Although mesenteric lymphadenitis can lead

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to systemic effects in some situations, it is not a universal outcome and should be assessed on a case-by-case basis. When the literature was searched, no study analyzed the relationship between mesenteric lymphadenitis and SIRS in detail.

The aim of this study was to evaluate the relationship between mesenteric lymphadenitis and SIRS.

Methods

Ethical approval was obtained from the Bandırma University Local Ethics Committee (KAEK-2024-01-01.1578) for this study, and the Helsinki principles were followed.

This retrospective cohort study was conducted at a single center over a 1-year period. Because this was a retrospective study, informed consent forms were not obtained from the patients.

A total of 58 patients who presented to the emergency department with acute abdominal pain and were diagnosed with mesenteric lymphadenitis on CT were evaluated. These patients evaluated were between the ages of 7 and 21. Patients whose CT was of poor quality and unsuitable for evaluation were excluded from the evaluation. Some pediatric patients aged 7-9 years were excluded from the study because of movement during imaging and an inability to cooperate with breath-holding instructions. Individuals diagnosed with conditions such as colitis, appendicitis, and other similar diagnoses, including mesenteric lymphadenitis, were also excluded. Furthermore, individuals with a history of hematological diseases were not included in the study.

Clinical, laboratory, and radiologic scans were obtained from the radiology information system and electronic medical record system.

Computed Tomography Scanners and Parametres

In this study, a 128-slice single-detector Somatom Go Top (Siemens, Erlangen, Germany) was used for abdominal CT imaging. The scan parameters included a field of view of 256 mm, a voltage of 120 kV, a current of 60 mA, and a slice thickness of 1 mm.

CT imaging was conducted during the portal venous phase using an iohexol nonionic contrast agent, except in patients with severe disease, renal failure (eGFR <30 mL/min), and suspected kidney stones.

Computed Tomography Diagnosis

All images were evaluated collaboratively by a radiology specialist with 10 years of experience and a radiology assistant with 1 year of experience. The radiologic diagnosis of mesenteric lymphadenitis was based on the following features: 3 mesenteric lymph nodes with a short axis diameter of 8 mm without any underlying inflammatory process identifiable by CT.[2]

Clinical Patient Data

The electronic medical record system and radiology information system were examined for admission complaints, vitals, blood results, and laboratory values of patients admitted to the emergency department. Patient age, gender, symptoms, examination findings, vital signs, C-reactive protein (CRP), and white blood cell (WBC) values were summarized.

Systemic Infammatory Response Syndrome

The vital characteristics and blood tests of the patients were evaluated according to whether they met the SIRS criteria.[4,5,7]

SIRS diagnostic criteria are met when at least two of the following are present.

1. Body temperature >38 °C or <36 °C,

2. Heart rate (HR) >90 beats per minute (bpm),

3. Respiratory rate (RR) >20 breaths/min,

4. White cell count (WCC) >12,000/mm^3 or <4000/mm^3.

Statistical Analysis

Statistical analysis was performed using Microsoft Excel functions on data entered a Microsoft Excel spreadsheet. Means, mean values, standard deviations (SD) and ranges were calculated for all continuous variables. A simple count analysis was performed for all variables. All qualitative information such as physical examination findings and radiological report data were noted. Odds ratio was used to investigate the association between mesenteric lymphadenitis and SIRS. The IBM Statistical Package for the Social Sciences statistics program was used when compared groups and p value <0.05 was considered statistically significant.

Results

A total of 58 patients (27 males and 31 females) with mesenteric lymphadenitis were included in the study. The mean age of these patients was 17.4±15.0 (mean±SD) years. Fever of 37.5 °C was recorded in 5 patients (8.6%). Fourteen patients had leucocytosis (24.1%) (WBC >11×10^9/L). The mean WBC count in the leucocytosis group was 14.7±12.1×10^9/L. Twenty-four patients (41.4%) had elevated CRP (>10 mg/L). The mean CRP level in this group was 15.2±14.1 mg/L. Tachycardia (>100 bpm) was detected in four patients (6.9%). The median HR in the tachycardic group was 123 bpm. Tachypnea (>20 breaths per minute) was recorded in 3 patients (5.2%). The median RR in the tachypneic group was 27 breaths/min. In our study, 12 patients (20.7%) fulfilled the SIRS criteria. The most frequently met SIRS criteria in these mesenteric lymphadenitis patients were fever (n=5), WCC (n=14), HR (n=4), and RR (n=3) (Figures 1 and 2).

Following CT diagnosis and treatment of mesenteric lymphadenitis, 53 (91.4%) patients were discharged directly from the emergency department and 5 (8.6%) patients were hospitalized. In our study, the hospitalization rate tended to be higher in the SIRS group (4/12 patients) than in the non-SIRS group (1/46 patients) (p<0.05).

In the SIRS-positive group, an additional radiological comorbidity not associated with mesenteric lymphadenitis was detected in 5/12 patients, 3 of whom were hospitalized.

Comorbidities included renal calculi (n=1), epiploic appendicitis (n=2), colitis (n=1), and Coronavirus disease-2019 (COVID-19) pneumonia (n=1) (Figure 1). In contrast, 7/12 patients in the SIRS-positive group had only mesenteric lymphadenitis without any other radiological comorbidity.

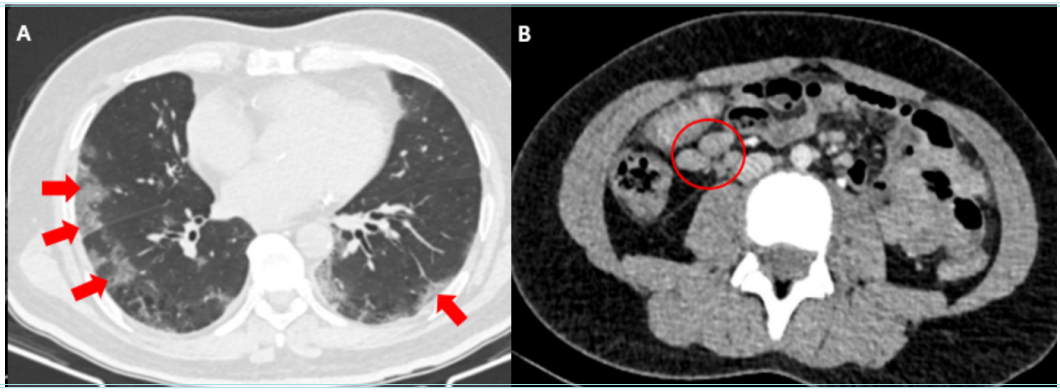

Figure 1. A) Non-contrast thorax CT axial slices show diffuse peripheral ground-glass opacities in a 35-year-old male patient with a diagnosis of COVID-19 (arrows). B) Contrast-enhanced abdominal CT axial sections show mesenteric lymphadenopathies with a short axis greater than 1 cm in the parachecal area in the right lower quadrant of the abdomen in the same patient with COVID-19 (circle). When evaluated together with clinical and laboratory data, it was confirmed to be compatible with mesenteric lymphadenitis

CT: Computed tomography, COVID-19: Coronavirus disease-2019

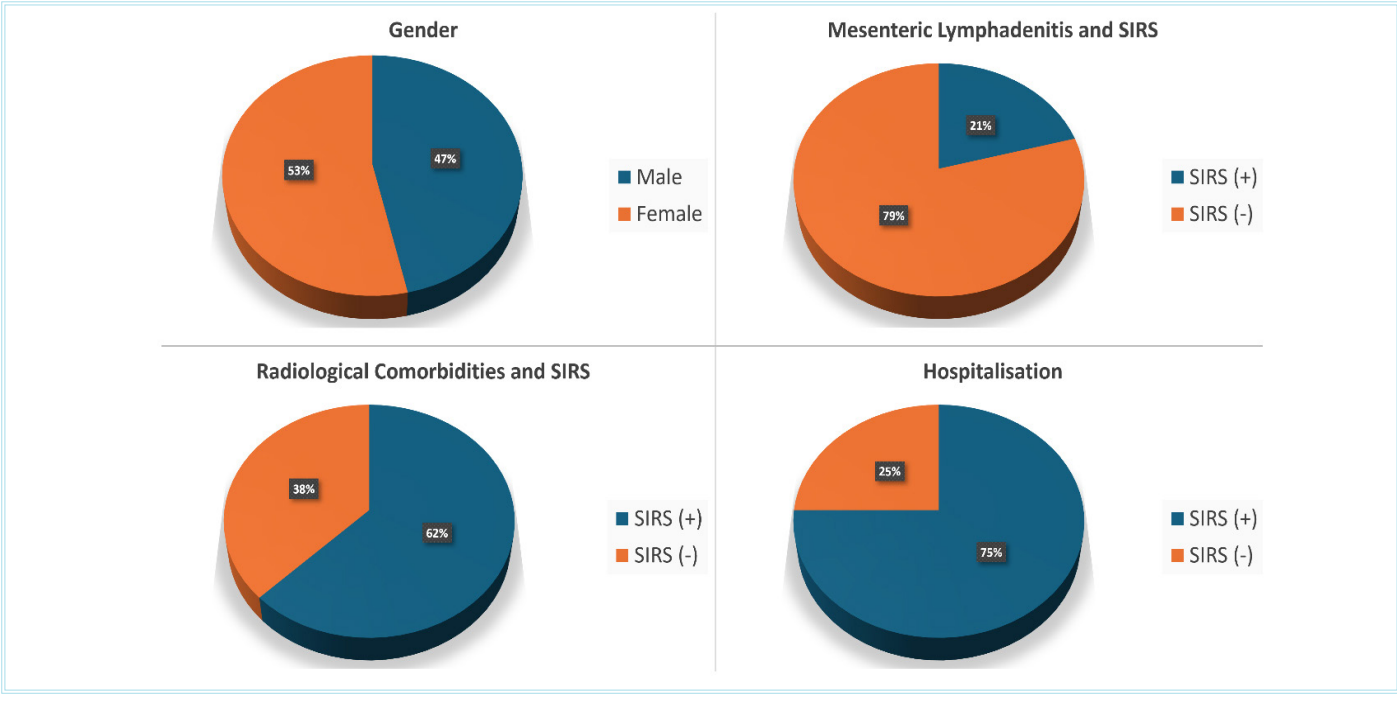

Figure 2. Gender distribution, percentage of SIRS, percentage of radiological comorbidities, hospitalization rates of patients diagnosed with SIRS

SIRS: Systemic inflammatory response syndrome

In the non-SIRS group, only 3/46 (6.5%) patients had radiological comorbidities, of whom only 1 was hospitalized. These comorbidities included urinary tract infection (n=3). All patients (discharged and admitted) were treated conservatively. Fifty-four patients received analgesia only, and four patients received antibiotics and analgesics.

Discussion

The relationship between mesenteric lymphadenitis and SIRS represents a complex interplay of local and systemic inflammatory responses. Mesenteric lymphadenitis, primarily characterized by swollen lymph nodes in the mesentery without an obvious cause of infection, often presents with symptoms similar to those of acute appendicitis.[8,9] Although typically self-limiting in nature, understanding when and how SIRS might progress is crucial for early diagnosis and management.[3,10]

SIRS is a generalized state of inflammation that can be triggered by a myriad of infectious and non-infectious causes, potentially leading to severe outcomes like sepsis or organ failure.[3,7] The criteria for diagnosing SIRS include the presence of two or more symptoms, such as fever, tachycardia, tachypnea, or altered WBC count.[5]

Studies indicate that while mesenteric lymphadenitis is primarily a localized infection, systemic symptoms suggesting SIRS can occasionally emerge, especially if the lymphadenitis is part of a broader infectious or inflammatory process[11,12]. For instance, elevated inflammatory markers

typically associated with SIRS, such as CRP and higher WBC counts, have been observed in some patients with mesenteric lymphadenitis.[8,13,14]

Furthermore, the progression from mesenteric lymphadenitis to SIRS appears to be influenced by factors such as patient age, immune status, and presence of comorbid conditions. Young children and immunocompromised patients are particularly susceptible to such progression because of their relatively weaker immune responses.[1,3]

Management strategies for mesenteric lymphadenitis should therefore not only focus on alleviating local symptoms but also monitor signs of systemic inflammation to prevent escalation to SIRS. Early intervention with antibiotics or supportive care reduces the likelihood of progression and improves outcomes.[3,10]

In our study, 58 individuals with mesenteric lymphadenitis (27 men and 31 women) were included in the research. Twenty-seven percent of the individuals in our study met the SIRS requirements. In these patients with mesenteric lymphadenitis, fever, WCC, HR, and respiration rate were the most common SIRS criteria that were satisfied. The SIRS group in our study had a greater hospitalization rate than the non-SIRS group.

Conclusion

Although mesenteric lymphadenitis and SIRS are primarily distinct conditions, their intersection in clinical scenarios underscores the importance of vigilant assessment and management to prevent potentially life-threatening complications. Further research is needed to better understand the mechanisms that underpin their relationship and refine strategies for intervention and management.

To the best of our knowledge, this is the first study in the literature to evaluate the relationship between mesenteric lymphadenitis and SIRS. Among the limitations of our study may be that it is monocentric, retrospective, and the number of patients is relatively small. It is also important to keep in mind that SIRS has a low specificity for infection and that age, immunosuppression, and pharmaceutical interactions can disguise specific criteria. As a result, the true prevalence of SIRS positivity may be underestimated, but it is anticipated to be greater.

Ethics

Ethics Committee Approval: Ethical approval was obtained from the Bandırma University Local Ethics Committee (KAEK-2024-01-01.1578).

Informed Consent: Since the study was a retrospective study, informed consent was not required by the ethics committee.

Authorship Contributions

Surgical and Medical Practices: E.T., Concept: E.T., Z.T., Design: E.T., Z.T., Data Collection or Processing: E.T., Analysis or Interpretation: E.T., Z.T., Literature Search: E.T., Writing: E.T., Z.T.

Conflict of Interest: No conflict of interest was declared by the authors.

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CASE REPORT

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Bizarre Parosteal Osteochondromatous Proliferation of the Humerus with Radiological Findings: A Case Report

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Abstract

Bizarre parosteal osteochondromatous proliferation (BPOP) is a rare, benign bone disease that primarily affects the metacarpals and metatarsals. We describe a 17-year-old male teenager with proximal humeral BPOP. It is a trabeculated osteolytic lesion on radiological examination. An excisional biopsy confirmed the diagnosis. Very few cases of BPOP in the long bones have been documented. It is an extension that emerges from the bone's cortical surface and is exophytic. Because the lesion was discovered in a rare location-the proximal diaphysis of the case is being reported. The gold standard for diagnosis is still the combination of radiographic and histological findings.

Keywords: BPOP, Bizarre parosteal osteochondromatous proliferation, Nora lesion, osteochondroma, osteolytic bone lesion

Introduction

Bizarre parosteal osteochondromatous proliferation (BPOP) is a relatively rare benign extraperiosteal osteochondroma-like proliferative lesion. Thirty-five cases involving the hands and feet were recorded when Nora et al. initially defined it in 1983 (1). Meneses et al. (2) identified 65 additional cases, with long bones being damaged in 17 of them.

Small bones in the hands and feet are most afflicted by this disorder, but long bones, vertebrae, skull, and jaw are also sporadically impacted (3). The hands account for most BPOP cases (55%), with feet coming in second (15%) and long bones in third (25%) (2). The second and third decades of life are when the incidence in adults peaks. It affects both men and women equally (3).

The normal presentation of BPOP is a firm, painful swelling that increases over time without causing harm. Diagnostic ambiguity arises from the rapid growth of this lesion and its similarity to malignant tumors like osteosarcoma and chondrosarcoma on imaging and histopathologic testing (2,3). The evaluation of both radiological and histological features is the basis for the diagnosis of BPOP (4). The cause of BPOP is currently unknown. The scarcity of BPOP means that the proof is scarce.

This study aimed to report this uncommon clinical condition and add to the body of knowledge regarding its management and aftercare.

Case Report

A 17-year-old boy presented with a 4-month history of swelling in his left shoulder. Upon investigation, a hard, painless swelling that was immobile was observed. There was no discomfort or limitation in motion. Trauma was not in the past.

The patient was first assessed using radiography. When an anteroposterior radiograph (Figure 1) revealed a well-defined radio-opaque bone lesion with exophytic extension in the proximal humerus, computed tomography (CT) was performed.

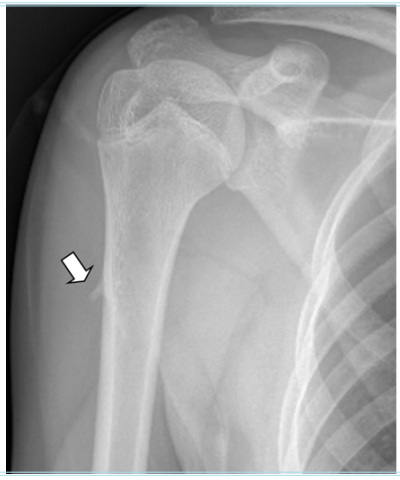

Figure 1. A well-defined radio-opaque bone lesion with exophytic extension in the proximal humerus (arrow)

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A smooth-circumscribed osseous lesion without medullary continuity was observed in the proximal diaphysis of the humerus on a non-contrast CT scan of the upper arm. The lesion extended exophytically from the cortex to the surrounding soft tissue (Figures 2A, 2B). In the soft tissue next to the identified lesion, no additional pathology was found (Figure 2C).

A pre-contrast T1-weighted magnetic resonance imaging (MRI) series revealed a bone lesion with bone-like density and a heterogeneous signal shift in the surrounding soft tissue. Soft tissue contrast uptake was used for the post-contrast MRI series (Figures 3A, 3B).

The main differential diagnoses were BPOP and parosteal osteosarcoma. An excisional biopsy of the lesion was performed to make a histological diagnosis. Histologically, the tumor surface contained fibrocartilaginous tissue with considerable cellularity. The cells varied in size, with some being binucleated. The basal area consisted of juvenile bone trabeculae with significant osteoblastic activity. The cells demonstrated abnormal mitosis but no cytologic atypia. Thus, the diagnosis of BPOP was confirmed.

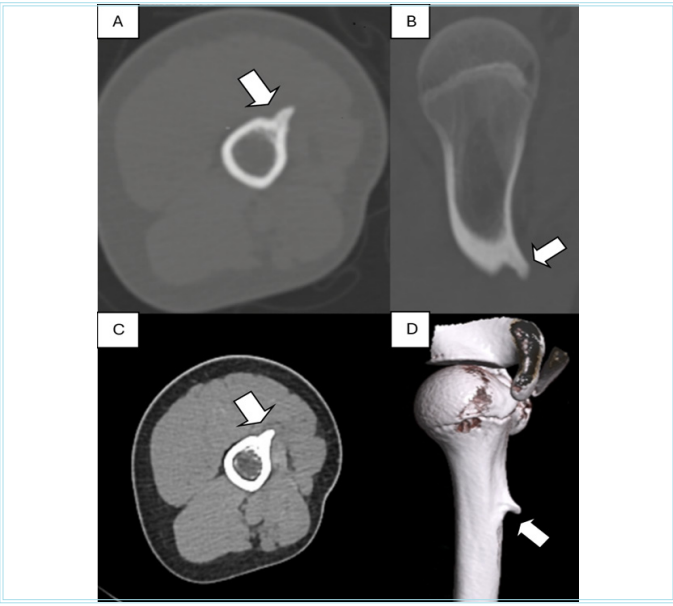

Figure 2. On a non-contrast computed tomography (CT) scan of the upper arm. An axial and coronal image displays a well-defined exophytic bone lesion in the bone window that lacks medullary continuity (A, B, arrow). The axial image shows no other pathology in the soft tissue adjacent to the lesion (C, arrow). We observe an exophytic bone lesion emanating from the diaphysis in the 3-dimensional-CT humerus image (D, arrow)

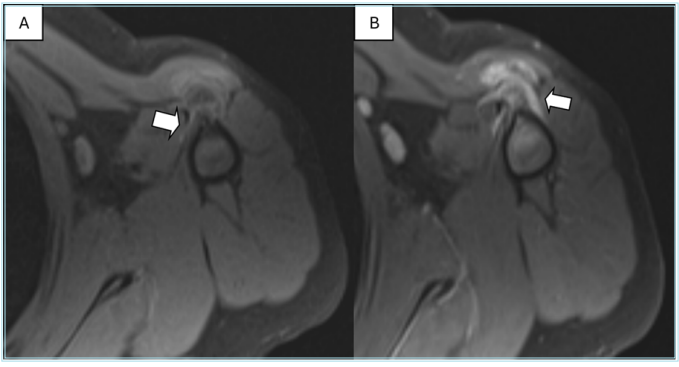

Figure 3. An exophytic bone lesion and a heterogeneous signal shift in the surrounding soft tissue are visible on pre-contrast T1-weighted magnetic resonance images (A, arrow). The lesion enhances similarly with the adjacent bone. Increased soft tissue contrast enhancement is seen in post-contrast magnetic resonance imaging series (B, arrow)

Discussion

BPOP of bone is an uncommon reactive bone lesion known as Noras lesion, which was initially identified by Nora et al. (1) in 1983. It primarily affects the bones of the hands and feet. Long bones, including the tibia, fibula, femur, radius, and ulna, are rarely impacted (2). It can affect people of all ages, but it is most common in the second and third decades. The ratio of men to women is equal. The most common cause of symptoms is edema (3). In our case, the swelling was painless, as described in the literature.

As far as we know, in the English literature, there have been around 200 cases of BPOP recorded to date. In addition to its rarity, BPOP is less common in long bones (4).

Even more uncommonly, one of the long bones, the humerus, was afflicted. Excision was performed, and the follow-up proceeded well.

According to the most extensive radiology-based study to date, BPOP is a well-defined mass of heterotopic mineralization arising from the periosteum, with an intact cortex and no medullary alterations (5). Periosteal new bone growth is not observed in BPOP. The lack of continuity between the lesion and the bone's medullary cavity is an essential radiographic finding that distinguishes BPOP from osteochondromas. In addition, there is no cortical hypertrophy (6).

Although BPOP has distinct clinical and histological features, it may be mistaken for other benign and malignant diseases. Because of its parosteal location, BPOP must be distinguished from parosteal osteosarcoma, which is uncommon in the hands and feet (7). The lack of cellular atypia distinguishes this disease from osteosarcoma. The lesion's surface position and cartilaginous component may lead to confusion with osteochondroma. Osteochondromas are relatively uncommon in the tiny bones of the distal extremities (8). They have typical continuity with the medullary canal, and the cartilage displays no symptoms of atypia.

Rybak et al. (9) described four cases of BPOP with corticomedullary continuity with the underlying bone on imaging, which was verified by pathological diagnosis. Thus, radiologic characteristics alone cannot define BPOP, according to Rybak et al.'s (9). For a conclusive diagnosis, a histopathological investigation should be performed.

In histological sampling, another important marker for the diagnosis of BPOP, there are three components of BPOP: cartilage, bone, and spindle cells. Cartilage usually forms a cap; less frequently, it is arranged in lobules separated by dense fibrous tissue with irregular maturation into bone (endchondral ossification) and spindle cells in the background. Cartilage is hypercellular and contains large chondrocyte. Binucleated cells are common, and hyperchromasia and cytologic atypia are absent. Mitotic figures are common but do not show atypia (2).

The bone lesion's radiologic and histopathologic characteristics in our instance matched those reported in the literature.

The rate of recurrence is approximately 50%. Thus far, no malignant transformation, metastasis, associated systemic disease, or death has been reported in patients with BPOP, despite the high recurrence and

emergence of aberrant histology. Given the frequency of recurrence, a broad excision would be beneficial (10,11).

Conclusion

In conclusion, long bones can also be affected by BPOP, which is a rare lesion of small bones. The gold standard for diagnosis is still the combination of radiographic and histological findings.

Ethics

Informed Consent: Written consent was obtained from the patients and their relatives who participated in this study.

Authorship Contributions

Surgical and Medical Practices: E.B., Concept: K.B.M., Design: E.B., Data Collection or Processing: K.B.M., Analysis or Interpretation: K.B.M., Literature Search: E.B., Writing: E.B., K.B.M.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

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