

Case Report

A Rare Pathology of a Child Rescued from the Rubble in the Kahramanmaraş Earthquake: Left Brachial Plexus Injury and Diaphragmatic Paralysis

Kahramanmaraş Depreminde Enkazdan Kurtarılan Çocukta Nadir Bir Patoloji: Sol Brakial Pleksus Yaralanması ve Diyafram Felci

Mutluhan Yiğitaslan¹, Gülenay Aktay¹, Eda Eyduran², Gülizar Koç², Gökçen Özçifci², Fatih Durak³,
Ayşe Berna Anıl³

¹*İzmir Tepecik Training and Research Hospital, Department of Pediatrics, İzmir, Türkiye*

²*İzmir Tepecik Training and Research Hospital, Pediatric Intensive Care, İzmir, Türkiye*

³*Katip Çelebi University Faculty of Medicine, Pediatric Intensive Care, İzmir, Türkiye*

ABSTRACT

The primary destructive effect of earthquakes is sudden devastating trauma. A healthy seven-year-old male was rescued after 35 hours under the rubble in Kahramanmaraş earthquake. CPR was performed at the scene, he was intubated and transferred to a nearest pediatric intensive care unit. He was followed in pediatric intensive care unit due to crush syndrome and lung contusion for two days and then transferred to ward. While receiving oxygen therapy at the ward, the patient was intubated due to sudden respiratory distress. Since there was no empty bed in the intensive care unit of the hospital, he was transferred to the intensive care unit of our hospital. The patient had effusion in the left hemithorax, hemorrhagic contusion in the right lung, and peri splenic fluid. The patient, who had hemodynamic instability, markedly high renal functions, widespread edema, oliguria and hematuria, received 24-hour hemodiafiltration treatment. After extubating, the patient continued to experience respiratory distress, had limited movement and weakness in the left upper extremity, and diaphragmatic elevation was identified on the left side in the chest X-ray. The patient was diagnosed with left brachial plexus injury and left diaphragmatic paralysis by thoracic ultrasound, cervical vertebrae and left brachial plexus MRI. Over time, respiratory stress was relieved and oxygen support was gradually reduced and discontinued. In conclusion, it is necessary to perform repeated neurological examinations after sedation is discontinued and to assess continued respiratory distress after extubating to detect trauma-related diaphragmatic paralysis.

Keywords: *Earthquake, pediatric intensive care, brachial plexus injury, diaphragmatic paralysis*

ÖZET

Depremlerin birincil etkisi ani yıkıcı travmadır. Kahramanmaraş depreminde enkaz altından 35 saat sonra 7 yaşında sağlıklı bir erkek kurtarıldı. Olay yerinde CPR yapıldı, entübe edilerek en yakın çocuk yoğun bakım ünitesine nakledildi. Ezilme sendromu ve akciğer kontüzyonu nedeniyle iki gün çocuk yoğun bakım ünitesinde takip edilen hasta, daha sonra servise devredildi. Serviste oksijen tedavisi gören hasta ani solunum sıkıntısı nedeniyle entübe edildi. Hastane yoğun bakım ünitesinde boş yatak bulunmadığından hastanemiz yoğun bakım üni-

Received: 15.08.2023 · **Accepted:** 15.10.2023 · **Published:** 15.11.2023

Correspondence / Yazışma: Mutluhan Yiğitaslan · İzmir Tepecik Eğitim Ve Araştırma Hastanesi, Çocuk Sağlığı ve Hastalıkları, İzmir, Türkiye · mutluhan.yigitaslan@gmail.com

Cite this article as: Yiğitaslan M, Aktay G, Eyduran E, Koc G, Ozcifci G, Durak F, et al. A Rare Pathology of a Child Rescued from the Rubble in the Kahramanmaraş Earthquake: Left Brachial Plexus Injury and Diaphragmatic Paralysis. *Pediatr Acad Case Rep.* 2023;2(supp1):8-11.

© 2023 Association of Pediatric Specialization Academy.

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited and is not used for commercial purposes (<http://creativecommons.org/licenses/by-nc/4.0/>).

tesine nakledildi. Hastanın sol hemitoraksta efüzyon, sağ akciğerde hemorajik kontüzyon ve dalak çevresinde sıvı mevcuttu. Hemodinamik instabilitesi, böbrek fonksiyonlarında belirgin yükseklik, yaygın ödem, oligüri ve hematüri bulunan hastaya 24 saat hemodiyafiltrasyon tedavisi uygulandı. Ekstübasyon sonrası solunum sıkıntısı devam eden hastanın sol üst ekstremitede hareket kısıtlılığı ve güçsüzlük mevcuttu ve çekilen akciğer grafisinde sol tarafta diyafragma elevasyonu tespit edildi. Toraks ultrasonu, servikal vertebra ve sol brakial pleksus MR'ı ile hastaya sol brakial pleksus yaralanması ve sol diyafragma felci tanısı konuldu. Zamanla solunum sıkıntısı azaldı ve oksijen desteği giderek azaltılarak kesildi. Sonuç olarak, travmaya bağlı diyafragma paralizisini saptamak için sedasyon kesildikten sonra tekrarlanan nörolojik muayenelerin yapılması ve ekstübasyon sonrası devam eden solunum sıkıntısının değerlendirilmesi gerekir.

Keywords: Deprem, çocuk yoğun bakım, brakial pleksus yaralanması, diafragma paralizisi

INTRODUCTION

The catastrophic effect caused primarily by an earthquake is the sudden, fatal trauma that occurs to people. From this point on, everything is directly related to physical trauma. Brachial plexus injury and diaphragmatic paralysis may occur due to traumatic or non-traumatic causes. While traumatic brachial plexus injury is observed in approximately 1% of multi-trauma adults, it is even rarer in multi-trauma children. Crush syndrome and multi-trauma are quite common in this patient group, whereas brachial plexus injury and diaphragmatic paralysis are rarely seen (1,2,3).

To our knowledge, there are not any reports in the literature about brachial plexus injury and diaphragmatic paralysis due to earthquake-related trauma in children. The case-report was presented to emphasize the traumatic brachial plexus injury in the differential diagnosis of multi-trauma children with the persistence of respiratory distress.

CASE REPORT

Previously healthy, a seven-year-old male earthquake survivor was rescued 35 hours after being trapped in the rubble and received cardiopulmonary resuscitation that lasted fewer than five minutes at the scene. Following successful resuscitation, the patient was intubated and transferred to a pediatric intensive care unit. The patient was followed in the pediatric intensive care unit due to crush syndrome and lung contusion for two days and then transferred to the ward to complete the therapy. While receiving oxygen therapy at the ward, the patient was intubated due to sudden respiratory distress. Since there was no empty bed in the intensive care unit of the hospital, he was transferred to the intensive care unit of our hospital. On admission, the patient was under sedation, intubated, had bilateral pupillary light reflexes and stable vital signs, such as heart rate was 120 beats per minute, blood pressure was 102/55 mmHg, and his oxygen saturation was 97%. The swelling was noted in the left occipitoparietal region, significant abrasions and ecchymoses were observed

on the left shoulder, reduced breath sounds were heard in the right hemithorax, and bilateral scrotal edema was present. Other system examinations were unremarkable.

Laboratory evaluation revealed the following: leukocytes: 19,300/mm³, Hb: 10 g/dl, platelets: 212,000/mm³, blood urea: 112 mg/dl, creatinine: 1.37 mg/dl, AST: 3061 U/L, ALT: 597 U/L, CK: 155472 U/L, LDH: 4154 U/L, CRP: 120.9 mg/L, procalcitonin: 72.4 ng/ml, troponin: 909 ng/L. Electrolytes and coagulation tests were within normal limits. Hematuria and proteinuria were detected in urine analysis. Myoglobulin level could not be measured in our hospital. Chest X-ray revealed images consistent with contusions in the right middle and basal regions (picture 1). Ultrasonography indicated a 2 cm effusion in the left hemithorax, hemorrhagic contusion in the right middle and lower lobes with loss of aeration, and minimal peri splenic fluid. Echocardiography results were normal. The patient received supportive treatments. Hemodiafiltration (HDF) due to oliguria, fluid overload, and unresponsiveness to furosemide treatment. Since the patient's hemodynamics were impaired and HDF has been associated with better hemodynamic stability, HDF was chosen as the renal replacement modality. HDF treatment was discontinued at the 24th hour because adequate urine output was observed, edema disappeared, and kidney functions decreased to normal levels.

On the fourth day of observation, with stable condition, the patient was extubated. He was conscious with a GCS score of 15. After extubating, the patient continued to experience respiratory distress, had limited movement and weakness in the left upper extremity, and diaphragmatic elevation was identified on the left side in the chest X-ray (picture 2). Thoracic ultrasound revealed that the left diaphragm was not moving with respiration. Thoracic CT did not reveal any additional pathologies apart from effusion and contusion. Cervical vertebrae and left brachial plexus MRI showed increased signal intensity at the level of C4-C5 nerves in

T2A, indicating injury. EMG of the left upper extremity revealed low-amplitude motor responses, while median and ulnar sensory responses could not be obtained. The patient was diagnosed with left brachial plexus injury and left diaphragmatic paralysis. Over time, respiratory stress was relieved, and oxygen support was gradually reduced and discontinued. The patient was enrolled in a physiotherapy program for brachial plexus injury and was discharged after one month of treatment follow-up.



Figure 1. Chest X-ray at admission

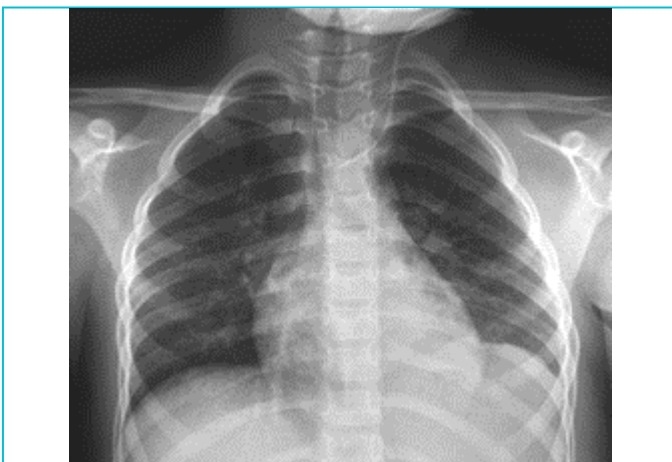


Figure 2. Diaphragmatic eventration

DISCUSSION

The brachial plexus is formed by the C5-Th1 nerve roots, with the C4 and C5 roots being connected fibrously. The diaphragm is innervated by the phrenic nerve, which originates from the C3 to C5 nerve roots. Diaphragmatic paralysis may develop due to muscular or neurological dysfunction. Traumatic birth or iatrogenic phrenic nerve injury during cardiothoracic surgery are common causes of unilateral diaphragmatic paralysis (4). Other less frequent causes include viral infections, primary myopathies, central nervous system disorders,

neuromuscular junction diseases, and rarely trauma (5). While traumatic brachial plexus injury is observed in approximately 1% of multi-trauma adults, its occurrence is much lower, around 0.1%, in children. Motor vehicle accidents involving head and lung traumas are the most common causes of traumatic brachial plexus injury (2). Following the Marmara earthquake in our country, a study conducted in a single center revealed brachial plexus injury in 16% of patients with peripheral nerve damage associated with the earthquake (6). The incidence of phrenic nerve injury associated with brachial plexus trauma varies between 10% to 20%; however, unilateral diaphragmatic paralysis can be asymptomatic, leading to the frequent oversight of phrenic nerve paralysis associated with brachial plexus injury (7). In our case, the patient suffered from severe lung contusion due to being trapped under debris during the earthquake, resulting in left brachial plexus injury and diaphragmatic paralysis.

Physical examination of brachial plexus injury reveals weakness and sensory findings, such as hypoesthesia and paresthesia. A complete neurological examination while the patient is awake is essential to suspect this diagnosis. However, it is often challenging to perform a complete neurological examination in sedated and intubated patients in the intensive care unit. As a result, neuromuscular dysfunctions may not be noticed initially (8). In our case, after the sedation was stopped and extubated, the examination performed on suspicion of left brachial plexus palsy revealed limitation of movement and weakness in the left upper extremity. The diagnosis was confirmed by MRI and EMG.

The diaphragm is the most crucial muscle for respiration. Although unilateral diaphragmatic paralysis often remains asymptomatic, it may rarely cause respiratory distress requiring mechanical ventilation (9). In our case, the patient initially required mechanical ventilation due to severe lung contusion, and the detection of unilateral diaphragmatic paralysis afterwards prolonged the duration of respiratory distress.

Although chest X-ray is highly sensitive in diagnosing diaphragmatic palsy, its specificity is not that high. However, observing diaphragmatic elevation on chest X-ray raises suspicion of diaphragmatic paralysis (10). M-mode ultrasound (USG) is increasingly preferred, particularly in pediatric patients, for evaluating diaphragm movement because it can be performed at the bedside with less need for patient cooperation (11,12). The "sniff" test, performed by observing diaphragmatic movement through fluoroscopy while instructing the

patient to take a sharp breath, can also confirm the diagnosis. The test shows that the paralyzed hemidiaphragm exhibits a paradoxical elevation during inspiration compared to the rapid downward movement of the normal hemidiaphragm. However, obtaining cooperation from pediatric patients for this test can be challenging. Advanced evaluation with thoracic computed tomography is used to assess the course of the phrenic nerve and exclude tumor invasion (13). In our case, the diagnosis of left diaphragmatic paralysis was confirmed through thoracic ultrasound following extubation, as the patient continued to experience respiratory distress and chest X-ray showed left diaphragmatic elevation. No additional pathologies were observed on thoracic CT.

When significant pathology is present in the lungs (e.g., effusion, contusion, and atelectasis) or positive pressure ventilation is applied, diagnosing diaphragmatic paralysis may be challenging (14). In our case, the presence of lung contusion and pleural effusion and the initial mechanical ventilation of the patient led us to suspect diaphragmatic paralysis during the post-extubation period.

In conclusion, in patients with trauma, brachial plexus injury and diaphragmatic paralysis are rare and can be overlooked. Therefore, it is necessary to perform repeated neurological examinations after sedation is discontinued and assess continued respiratory distress after extubating to detect these rare conditions.

Patient Consent Form / Hasta Onam Formu

The parents' of this patient consent was obtained for this study.

Conflict of Interest / Çıkar Çatışması

The authors declared no conflicts of interest with respect to authorship and/or publication of the article.

Financial Disclosure / Finansal Destek

The authors received no financial support for the research and/or publication of this article.

REFERENCES

1. Midha R: Epidemiology of brachial plexus injuries in a multitrauma population. *Neurosurgery* 40:1182–1189, 1997
2. Dorsi MJ, Hsu W, Belzberg AJ. Epidemiology of brachial plexus injury in the pediatric multitrauma population in the United States. *J Neurosurg Pediatr.* 2010;5:573Y577.
3. Iskit SH, Alpay H, Tuğtepe H, et al. Analysis of 33 pediatric trauma victims in the 1999 Marmara, Turkey earthquake. *J Pediatr Surg.* 2001;36(2):368-372.
4. McCool FD, Manzoor K, Minami T. Disorders of the diaphragm. *Clin Chest Med.* 2018;39(2):345–60.
5. Agarwal AK, Lone NA. Diaphragm Eventration. [Updated 2023 Apr 23]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-.
6. Uzun N, Savrun FK, Kiziltan ME. Electrophysiologic Evaluation of Peripheral Nerve Injuries in Children Following the Marmara Earthquake. *Journal of Child Neurology.* 2005;20(3):207-212.
7. Chen ZY, Xu JG, Shen LY, et al. Phrenic nerve conduction study in patients with traumatic brachial plexus palsy. *Muscle Nerve* 2001;24:1388–90
8. Simpson AI, Vaghela KR, Brown H, et al. Reducing the Risk and Impact of Brachial Plexus Injury Sustained From Prone Positioning-A Clinical Commentary. *J Intensive Care Med.* 2020;35(12):1576-1582.
9. Lisboa C, Paré PD, Pertuzé J, et al. Inspiratory muscle function in unilateral diaphragmatic paralysis. *Am Rev Respir Dis* 1986;134:488-92.
10. Chetta A, Rehman AK, Moxham J, et al. Chest radiography cannot predict diaphragm function. *Respir Med* 2005;99:39–44
11. Yajima W, Yoshida T, Kondo T, Uzura M. Respiratory failure due to diaphragm paralysis after brachial plexus injury diagnosed by point-of-care ultrasound. *BMJ Case Rep.* 2022;15(2):e246923.
12. Epelman, M., Navarro, O.M., Daneman, A. et al. M-mode sonography of diaphragmatic motion: description of technique and experience in 278 pediatric patients. *Pediatr Radiol* 35, 661–667 (2005)
13. Laghi, F.A., Saad, M. & Shaikh, H. Ultrasound and non-ultrasound imaging techniques in the assessment of diaphragmatic dysfunction. *BMC Pulm Med* 21, 85 (2021).
14. Panda A, Kumar A, Gamanagatti S, et al. Traumatic diaphragmatic injury: a review of CT signs and the difference between blunt and penetrating injury. *Diagn Interv Radiol* 2014;20:121–8.