CASE REPORT
Vol. 10 No. 3 July-September 2025
doi: 10.35366/120491

Tracheal injury from blunt trauma and electrical burn in infant with primary repair by tracheoplasty

Lesión traqueal por trauma directo y quemadura eléctrica en infante con reparación primaria por traqueoplastia

Reynaldo J. Jiménez-González,* María C. Ogaz-Escarpita,* Raúl M. Guillén-Ramírez,‡ Rigoberto Marmolejo-Rivera* and Ovidio A. García-Villarreal§

* Department of Cardiac Surgery, Hospital Ángeles Chihuahua. Chihuahua, Chihuahua, Mexico.
‡ Department of Cardiovascular Anesthesia, Hospital Ángeles Chihuahua. Chihuahua, Chihuahua, Mexico.
§ Mexican College of Cardiovascular and Thoracic Surgery. Mexico City, Mexico.

ABSTRACT

Cervical injuries occur in 10-23% of trauma injuries. The trachea is one of the most affected areas. We report a challenging case of a pediatric patient who suffered a tracheal trauma caused by two types of injury: electrical burn and blunt trauma. Due to the age of the patient and the mechanism of injury, its repair by tracheoplasty was essential to avoid compromise of the airway development.

Keywords: tracheal injuries, blunt trauma, electrical burn, tracheoplasty.

RESUMEN

Las lesiones cervicales se presentan en 10-23% de los traumatismos. La tráquea es una de las zonas que más se ve afectada. Se describe el caso de un paciente pediátrico que sufrió un traumatismo traqueal causado por dos tipos de lesión: quemadura eléctrica y traumatismo contuso. Debido a la edad del paciente y el mecanismo de lesión, resulta fundamental su reparación por medio de traqueoplastia para no comprometer el desarrollo de la vía aérea.

Palabras clave: *lesiones traqueales, traumatismo contuso, quemadura eléctrica, traqueoplastia.*

Of the total number of traumas affecting the cervical region, approximately 5-8% are injuries localized to the cervical vertebrae,[1] whereas tracheal injuries are more common, accounting for 10-23% of the series.[1,2] Notably, the majority of these traumas occur in men under the age of 40, with a male-to-female ratio of 3:1.[3]

In order to facilitate the diagnosis and treatment of cervical injuries, the neck is anatomically divided into three zones. Zone I encompasses the subclavian and carotid arteries, jugular vein, vagus nerves, and trachea.[4] Penetrating trauma is the primary mechanism of injury affecting this zone, resulting in a mortality rate of 11%.[5] When trauma occurs in this area, tracheal injury is clinically evident by the presence of subcutaneous emphysema, dyspnea, and even air escaping through the wound.[6]

Electrical burn injuries occur when a patient comes into direct or indirect contact with an electric current.[7] In children, such injuries are relatively uncommon, typically affecting individuals between the ages of 11 and 20.[3] The characteristic lesion associated with this type of trauma is coagulative

How to cite: Jiménez-González RJ, Ogaz-Escarpita MC, Guillén-Ramírez RM, Marmolejo-Rivera R, García-Villarreal OA. Tracheal injury from blunt trauma and electrical burn in infant with primary repair by tracheoplasty. Cir Card Mex. 2025; 10 (3): 95-98. https://dx.doi.org/10.35366/120491

Received: 04-08-2025. Accepted: 04-15-2025.

Correspondence: Dr. Reynaldo J. Jiménez-González. E-mail: jesusr72@hotmail.com

necrosis, resulting from the disruption of cellular membranes in the affected tissues.[8]

Neurological damage occurs due to ischemia in tissues supplied by the damaged vessels immediately following electrocution.[9] When such injuries occur at the cervical level, they can be severe due to the concentration of vital structures in close proximity within a confined anatomical area.[10]

Since this type of burn injury predominantly affects deeper tissue planes, assessing the extent of the burns by examining the skin surface is of limited utility, as it does not accurately reflect the magnitude of damage to internal organs.[1,11,12]

CASE DESCRIPTION

A 10-year-old male suffered a catastrophic accident on March 29, 2024, when he inadvertently fell onto an electrified cattle fence in a rural area, resulting in a complex cervical trauma involving both compression contusion and electrical burns. Upon admission, the patient presented with severe symptoms, including generalized emphysema, shock, bilateral tension pneumothorax, and extensive subcutaneous emphysema extending from the forehead to the proximal third of both thighs. A distinctive longitudinal lesion was observed in the neck area, characterized by a closed and well-delimited wound caused by the dual mechanisms of electrical burns and compressive trauma. Given the dual trauma mechanisms involved, prioritizing treatment and tracheal repair was crucial to ensure optimal airway development. The high-voltage electric current, estimated to be at least 6,000 volts, posed a significant risk of restenosis and laryngeal nerve damage, which would likely impact the patient's long-term prognosis.[13] Following a comprehensive evaluation, the tracheoplasty technique was deemed the most suitable option for this patient.

Figure 1: Simple computed axial tomography showing tracheal stenosis at the C7 level.

Figure 2: Surgical exposure of the tracheal lesion.

Simultaneous management of shock and pneumothorax was initiated, involving bilateral thoracostomy tube placement with subsequent water seal drainage, which effectively achieved drainage. Given the presence of circumferential ecchymosis and abundant blood clots, a post-intubation fibrobronchoscopy was performed to investigate suspected airway injury. Computed axial tomography (CT) revealed tracheal widening at the C7 level, consistent with an anterior traumatic lesion of the trachea *(Figure 1)*.

The patient's hemodynamic stability allowed for transfer to the intensive care unit, where he remained for four days before being evaluated for surgical intervention. A Kocher approach was employed, revealing ecchymosis in all planes, and the infrahyoid muscles were dissected. The thyroid gland was found to be extensively infiltrated by a post-traumatic hematoma, prompting the decision to open the isthmus to expose the cervical trachea. A longitudinal lesion was identified, involving the tracheal cartilages and the posterior surface of the thyroid gland at the C7 level. Following thorough washing, debridement, and remodeling of the tracheal cartilages, a tracheoplasty was performed using a conventional technique: termino-terminal anastomosis with subtotal points of absorbable PDS 5/0 material. Upon completion of the anastomosis, a water tightness test was conducted to ensure integrity *(Figures 2 to 4)*. After verifying hemostasis, a closed wound drainage system was implemented prior to layered closure.

Upon completion of the procedure, a concurrent bronchoscopy was performed, which revealed no evidence of lesions and confirmed that the repair area was hermetically sealed. Subsequently, bronchial lavage was conducted, resulting in the extraction of hematic remnants. Following orotracheal intubation, the patient was transferred to the intensive care unit, where he demonstrated a favorable progression and was successfully weaned off the ventilator.

By the fourth postoperative day, the patient began oral intake and mobilization without experiencing any additional complications. He was subsequently transferred to the pediatric ward, where he showed no signs of stridor, dyspnea, or dysphonia. The patient was ultimately discharged without any further complications.

COMMENT

The most common cause of tracheal stenosis is prolonged intubation, followed by trauma or neoplasia. The definitive treatment for this condition is tracheoplasty, which involves resection of the affected segment and end-to-end anastomosis of the healthy segments.[14] Notably, the complication rate for this procedure is reported to be approximately 33%, with restenosis being the most frequent complication, occurring in around 21% of cases.[15] A crucial aspect of tracheoplasty is ensuring that the distal ends are aligned without tension before resecting the injured portion of the trachea, as this helps prevent the development of stenosis.[16] Several factors are associated with complications during anastomosis, including pediatric age, which is a significant consideration.[17] Pediatric patients tend to have shorter tracheal lengths and smaller transverse diameters compared to adults, making trauma in this population more severe due to the larger surface area of affected tissue.[18] Consequently, tracheal stenosis in children is a complex pathology that requires a carefully defined treatment approach. The success of tracheoplasty depends on timely assessment to confirm the diagnosis, determine the extent and location of the stenotic area, and evaluate the degree of obstruction.[19]

Figure 3: Tracheal repair by tracheoplasty with end-terminal junction.

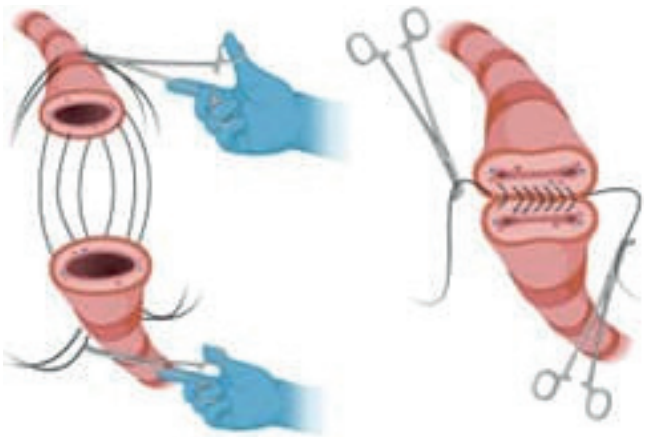

Figure 4: Schematic diagram of the surgical technique of tracheoplasty with termino-terminal junction.

CONCLUSION

Although tracheoplasty is the preferred procedure for treating tracheal stenosis in pediatric patients,[20] it is a complex surgical intervention associated with a range of potential complications, including restenosis and anastomotic dehiscence.

REFERENCES

1. Magaña SI, Cabello PR, Melgoza MD, Galván RJ, Chávez RJJ. Patrón de lesiones de cuello en el Hospital Central Militar. Cir Gen. 2001;23(4):240-244.
2. Vázquez-Minero JC, Morales-Gómez J, Guzmán-de Alba E, et al. Penetrating tracheal trauma. Recommendations for its management. About a case. Neumol Cir Torax. 2018;77(4):286-292.
3. Gonzalez Castro LF, Ávila Vargas SV, Quezada-Rueda JT, Vivas-García SM. Physiopathology of electrical burns: review article. Rev Argent Cir Plástica. 2018;24(2):51-56. doi: 10.32825/RACP/201802/0051-0056.
4. Fernández Russo GAH. Anatomía clínica y quirúrgica del cuello. Rev Arg Anat Onl. 2012;3(supl 3):7-113.
5. Millán HM, Gómez BJ, Hernández HJ, Duhalde SI. Manejo del trauma penetrante cervical de Zona II. Hospital Clínico Regional Valdivia. Serie de casos clínicos. Cuad Cir. 2008;22:11-17. doi: 10.4206/cuad.cir.2008.v22n1-02.
6. Koletsis E, Prokakis C, Baltayiannis N, Apostolakis E, Chatzimichalis A, Dougenis D. Surgical decision making in tracheobronchial injuries on the basis of clinical evidences and the injury's anatomical setting: a retrospective analysis. Injury. 2012;43(9):1437-1441. doi: 10.1016/j.injury.2010.08.038.

7. Kamble PB, Kshirsagar HS. A retrospective analysis of electrical burn injuries. Int J Community Med Public Health. 2023;10(12):4677-4683. doi: 10.18203/2394-6040.ijcmph20233762.
8. Knuth CM, Auger C, Jeschke MG. Burn-induced hypermetabolism and skeletal muscle dysfunction. Am J Physiol Cell Physiol. 2021;321(1):C58-C71. doi: 10.1152/ajpcell.00106.2021.
9. Yiannopoulou KG, Papagiannis GI, Triantafyllou AI, et al. Neurological and neurourological complications of electrical injuries. Neurol Neurochir Pol. 2021;55(1):12-23. doi: 10.5603/JNNS.a2020.0076.
10. Ramírez-Morin MA, Vergara-Miranda H, Guerrero-Arroyo AA, et al. Penetrating cervical trauma: experience of a teaching hospital in Mexico. Rev Colomb Cir. 2022;37(3):393-400. doi: 10.30944/20117582.1285.
11. Friedstat J, Brown DA, Levi B. Chemical, electrical, and radiation injuries. Clin Plast Surg. 2017;44(3):657-669. doi: 10.1016/j.cps.2017.02.021.
12. Braga MJ, Oliveira I, Egipto P, Silva A. High-voltage electrical burns due to copper theft - Case series. Ann Burns Fire Disasters. 2016;29(1):41-42.
13. Chahín AM, Fernández CM, Riquelme PI. Instalación y manejo de cerco eléctrico con ganado ovino [Internet]. Temuco (Chile): Instituto de Investigaciones Agropecuarias, INIA Carillanca; 2023. (Informativo INIA Carillanca; no. 181). Disponible en: https://hdl.handle.net/20.500.14001/69014
14. Obregón-Guerrero G, Martínez-Ordaz JL, Peña-García JF, Ramírez-Martínez M, Jurado-Reyes J, Pérez-Álvarez C. Anastomotic complications following tracheal plasty for postintubation tracheal stenosis. Cir Cir. 2013;(6):485-489.
15. Berrios-Mejía JA, Morales-Gómez J, Guzmán-de Alba E, Martín-Ibarra J, Zotés-Valdivia VH, Téllez-Becerra JL. Tracheal and laryngotracheal resection in tracheal stenosis: predictors of postoperative recurrence. Neumol Cir Tórax. 2016;75(4):275-280. doi: 10.35366/69365.
16. Rea F, Callegaro D, Loy M, Zuin A, et al. Benign tracheal and laryngotracheal stenosis: surgical treatment and results. Eur J Cardiothorac Surg. 2002;22(3):352-356. doi: 10.1016/s1010-7940(02)00342-1.
17. Wright CD, Grillo HC, Wain JC, et al. Anastomotic complications after tracheal resection: prognostic factors and management. J Thorac Cardiovasc Surg. 2004;128(5):731-739. doi: 10.1016/j.jtcvs.2004.07.005.
18. Coskun ZK, Atalar K, Akar B. Systematic literature study of trachea and bronchus morphology in children and adults. Folia Morphol (Warsz). 2023;82(3):457-466. doi: 10.5603/FM.a2022.0073.
19. Ashiku SK, Kuzucu A, Grillo HC, et al. Idiopathic laryngotracheal stenosis: effective definitive treatment with laryngotracheal resection. J Thorac Cardiovasc Surg. 2004;127(1):99-107. doi: 10.1016/j.jtcvs.2002.11.001.
20. Zaldívar Cervera JA, Santiago Romo JE, Mora Fol R, Torres Guillén NA, Carega Reyna G. Manejo quirúrgico de la estenosis traqueal en pediatría. Experiencia de 2001 a 201. Neumol Cir Torax. 2011;70(4):243-246.

Funding: none.
Disclosure: the authors have no conflicts of interest to disclose.