AFMN BIOMEDICINE

CASE REPORT

SEAT BELT SYNDROME: THYROID CARTILAGE FRACTURE

Sladjana Andjelić[1] **Eleftheria Papadopoulou**[2] **Tanja Nikolić**[3] **Goran Čolaković**[1] **Milena Popović**[1]

[1]Institute for Emergency Medicine, Belgrade, Serbia [2]Tzaneio General Hospital of Piraeus, Piraeus, Greece [3]Ars Medica, Belgrade, Serbia

Seat belt syndrome (SBS) is a new pattern of injuries in road traffic accidents (RTAs). It refers to injuries caused by the interaction of the human body and the safety belt and consists of a wide spectrum of injuries (musculoskeletal and visceral).

In this paper, we present a case of a front-seat passenger with polytrauma sustained in an RTA, who, as a literature rarity, also suffered a thyroid cartilage fracture (TCF) caused by a seat belt.

Thyroid cartilage fracture should be kept on the list of possible injuries with a high index of suspicion for this syndrome, based on the mechanism of injury and hyperflexion of the neck, even without signs of direct neck trauma.

Keywords: seat belt syndrome, traffic accident, thyroid cartilage fracture

Submitted: September 16, 2024 **Accepted:** November 3, 2024
Published online: December 17, 2025

Correspondence to:
Sladjana Andjelić
Institute for Emergency Medicine Belgrade
Franse d'Eperea 5, Belgrade, Serbia
E-mail: sandjelic94@gmail.com

INTRODUCTION

Motor vehicle accidents are one of the most significant causes of morbidity and mortality worldwide (1). In 2021, in Serbia, 482 road traffic accidents (RTA) with fatalities were recorded, in which a total of 521 people lost their lives: 229 in passenger cars (44%), 148 pedestrians (28%), and 48 cyclists (9%), while more than 13.000 were injured (2).
The use of seat belts (SB) as protective systems for drivers and passengers in the car is one of the indicators of traffic safety (3). Properly fastened, seat belts reduce the deceleration force on passengers in the moment of impact, extend the stopping distance for the passengers' bodies, distribute the impact force over a larger surface area, and reduce the effect of the impact force with their elasticity. They also prevent secondary collisions between passengers and the vehicle's internal structures, as well as ejection from the vehicle during or after the crash (3). The protective effect of the seat belt is enhanced when combined with airbags. Serbian research shows that 37% of the passengers who die in RTAs die as a result of improperly fastened seat belts (2). Seat belts are responsible for distinctive injury patterns known as the "seat belt syndrome" (SBS) (4). SBS consists of the following triad: superficial skin bruises, visceral injuries, and musculoskeletal injuries (5).
Herein, we present the case of a front-seat passenger (FSP) with polytraumatic injuries sustained in an RTA, who, in addition to the usual SBS injuries, also suffered from a thyroid cartilage fracture (TCF), which is a rarity in the literature.

CASE REPORT

The car veered out of control in an RTA involving a married couple in a car on a highway, with the husband as the driver and the wife as the front seat passenger. The car struck a concrete wall with the front passenger side of the vehicle. The wife, aged 58, was injured. The car was moving at a speed of 60 km/h, and at the moment of the collision, the wife (the front seat passenger) noticed that the steering wheel was unresponsive and the car was moving on its own accord. Attempting to regain control of the vehicle, she made a motion of hyperflexion and lateral extension of the spine. She was in that position when the car collided with the concrete wall.
The Emergency Medical Services (EMS) and firefighters were called to extract the woman from the automatically locked car and release her from the seatbelt and deployed airbag (Figure 1).

Figure 1. *The appearance of the impacted vehicle with the patient inside*

The EMS team found the front seat passenger conscious and actively mobile inside the vehicle. She denied having lost consciousness or suffering from chronic disease. She complained of dysphagia and odynophagia.
She was afebrile, slightly cyanotic, anicteric, hoarse, dysphonic, and dyspnoeic. Her vital signs were: a pulse of 78 beats/min; blood pressure of 110/80 mm Hg; respiratory rate of 28 breaths/min, blood oxygen saturation by pulse oximetry on ambient air at 79%, and blood glucose level at 7 mmol/l. There were no visible head injuries. She was noted to have an anterior midline transverse neck bruise in zone 2 (Figure 2).

Figure 2. *External neck sign (anterior midline transverse neck bruise in zone 2)*

Her neck showed slight oedema with crepitations and subcutaneous emphysema, and the trachea was positioned midline. The right arm was in a forced position, edematous, deformed, and painful, with a palpable peripheral pulse. Other physical findings were normal.
She was extracted from the vehicle using a cervical collar and vest-type extrication device. Her right arm was immobilised, oxygen was administered by mask at a flow rate of 4 L/min (resulting in SaO2 of 85%), and intravenous (IV) opioid derivates and lactated Ringer's solution were administered. She was unable to tolerate the supine position and was transported to the hospital in a seated position with vital signs continuously monitored.

Upon admission, a comprehensive diagnostic workup was performed: laboratory tests, chest X-ray, radiographs of the right humerus and forearm, multidetector computed tomography (MDCT) scan of the neck, thorax, and abdomen (plain and after IV contrast administration), Doppler of the blood vessels of the neck, and echocardiography. The following diagnoses were established: fractures of the proximal humerus and the wrist, the second and third right rib fractures, and a larynx injury to the glottis and subglottis, with a TCF at the level of the anterior commissure (Figure 3).

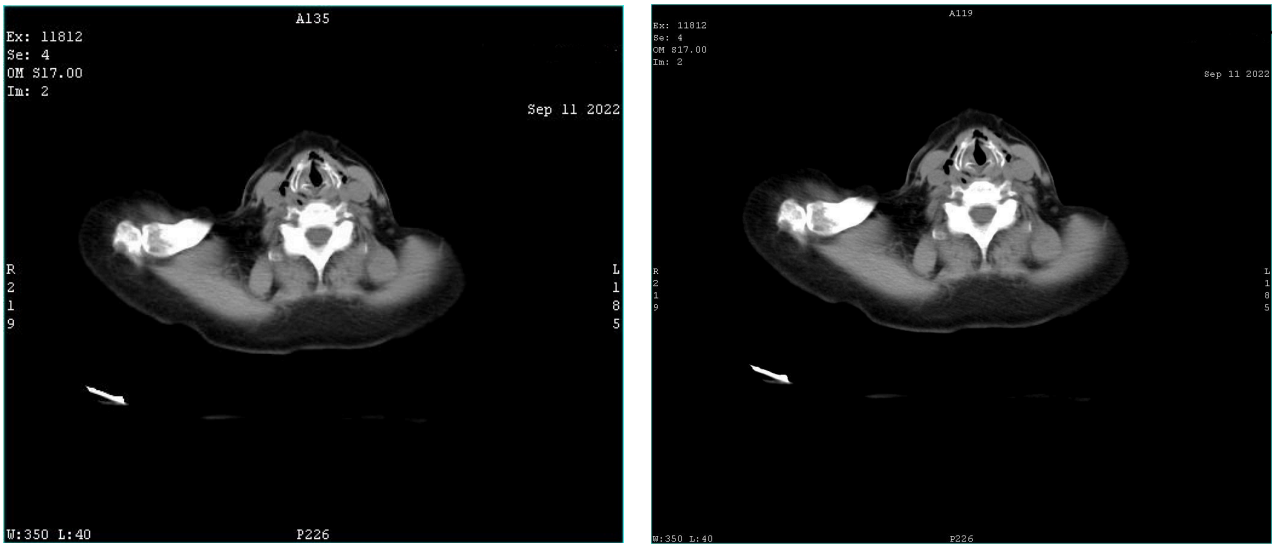

Figure 3. *Multidetector computed tomography scan of the neck: a thyroid cartilage fracture at the level of the anterior commissure with laryngeal injury of both the glottis and subglottis, and signs of pronounced emphysema in the soft tissues of the neck around the larynx and the retropharyngeal space*

There were signs of pronounced soft tissue emphysema in the laryngeal and retropharyngeal regions of the neck. The vocal cords were slightly voluminous. There were signs of pneumomediastinum–a small amount of free air along the esophagus. There were no fluid collections in the mediastinum. The trachea and main bronchi showed no obstruction, and the tracheal wall was intact. There were no signs of pneumothorax or pleural effusions. Pulmonary parenchyma showed no infiltrative-nodular changes, collapse zones, or consolidations. There were no traumatic lesions to the parenchymal organs and no free air or fluid in the abdomen.
A manual repositioning of the right arm was performed. Intravenous antibiotics, corticosteroids, and H2-receptor antagonists were administered. Hospitalisation and emergency tracheotomy (ET) were suggested, which the patient refused, and insisted on conservative management.
One year later, the patient recovered, but the thyroid cartilage healed irregularly with residual hoarseness as a permanent disability.

DISCUSSION

Our patient met all the criteria for SBS: an anterior midline transverse neck bruise, a laryngeal injury of the glottis and subglottis with TCF, fractures of the second and third ribs, signs of neck emphysema, voluminous vocal cords, and

signs of pneumomediastinum. According to Clement & Kelechukwu's classification (5) of SBS (overt and covert), our patient is classified as type one.

The presence of a seat belt sign increases the likelihood of chest injury by nearly four times and is a sign of some form of internal injury in 30% of cases (5), while its absence does not exclude the presence of other components of the SBS (6).

Although sporadic, occurring in less than 5% of all neck injuries, laryngeal injury (LI) can be life-threatening for the injured patient. Sittitrai et al. (6) concluded in a retrospective study that 86% of blunt LI occurred in motor vehicle collisions. Typically, LI is associated with other injuries in polytrauma, as was the case with our patient.

TCF is a rare but life-threatening injury because the thyroid cartilage is the only laryngeal cartilage necessary for the stability and integrity of the airway (7). The TCF occurs when the force of impact causes hyperflexion of the neck that exceeds the maximum flexibility of the thyroid cartilage. This mechanism of injury was present in our case, where the seat belt limited the neck hyperflexion.

During the initial approach to an RTA-related injury, it is important to note the characteristics of the injured and the mechanism of injury (the type of vehicle, speed, collision type, vehicle deformation, and body kinematics). In our case, the car was travelling at a speed of 60 km/h, it hit a wall on the front passenger's side, and the force of impact activated the airbag and automatically locked the vehicle door. A high index of suspicion for TCF in our patient's case should be considered because of the deceleration of the body, the hyperflexion of the neck during the collision, and the presence of the external neck sign. Taiwanese authors report an unrestrained car passenger with an isolated TCF caused by head impact on the windshield and neck hyperflexion during an RTA (8).

Three clinical findings indicate the presence of laryngeal fractures: hoarseness, subcutaneous emphysema, and a palpable fracture (6). Even though our patient was wearing a seat belt, she suffered polytraumatic injuries, with an emphasis on a potentially life-threatening airway obstruction (LAO) due to TCF, neck emphysema, and pneumomediastinum. Timely diagnosis and treatment are often crucial for the survival of severely injured patients with SBS. Computed tomography is considered the gold standard for diagnosing LI (9), and ET is the treatment of choice for LAO.

According to Fuhrman et al. (10), ET is justified even without a prior laryngoscopic examination if the patient cannot tolerate being in the supine position. According to Schaeffer's classification (Table 1) (11), our patient also suffered from a type II injury (oedema, hematoma, minor mucosal disruption without exposed cartilage, and non-displaced fractures on CT scan) which indicated an ET to provide respiratory clarity. Our patient, however, refused to be admitted to the hospital, as well as undergoing ET and insisted on conservative treatment.

Seat belt syndrome is a new pattern of injuries in RTAs, even when the seat belt is properly fastened. Thyroid cartilage fracture should be kept on the list of possible injuries with a high index of suspicion in cases with SBS, based on the mechanism of injury and external signs of laryngeal trauma.

Table 1. *Schaefer–Fuhrman Classification of laryngeal injuries (11)*

Group	Symptoms	Sings	Management
I	Minor airway symptoms	Minor endolaryngeal hematoma, edema or laceration without detectable fracture	Observation, humidified O2
II	Airway compromise	Edema or hematoma, minor mucosal disruption without exposed cartilage and non-displaced fractures noted on CT	Tracheostomy, direct laryngoscopy, esophagoscopy
III	Airway compromise	Massive edema, mucosal disruption, displaced fractures, exposed cartilage and/or cord immobility	Tracheostomy, exploration/repair
IV	Airway compromise	Group III + two or more fracture lines, skeletal instability or significant anterior commissure trauma	Tracheostomy, exploration/repair, stent required

Acknowledgements

This study was not supported by any sponsor of funder.

Statement of Ethics

Complete written informed consent was obtained from the involved patient for the publication of the study and accompanying images.

Competing Interest

The authors declared no relevant conflicts of interest.

REFERENCES

1. Anjuman T, Hasanat-E-Rabbi S, Siddiqui CKA, Hoque MM. Road traffic accident: a leading cause of the global burden of public health injuries and fatalities. In Proc Int Conf Mech Eng Dhaka Bangladesh; 2020.

2. Statistical report on the state of road traffic safety in the Republic of Serbia for 2021. Road Republic of Serbia: Traffic Safety Agency, Belgrade, 2022.

3. Marcikić Dmitrović M, Kraus Z, Mrčela M. Seat belt and fatal injury. Med Vjesn. 1993; 25 (3-4): 183--187.

4. Garrett JW, Braunstein PW. The seat belt syndrome. J Trauma. 1962;2(3):220-38. [CrossRef]

5. Clement O, Kelechukwu O. Classification of Seat Belt Syndrome. World J Surg Surgical Res 2019; 2:1093.

6. Sittitrai P, Ponprasert V. Acute external laryngeal injury. J Med Assoc Thai. 2000;83(11):1410-4.

7. Mehrabi S, Hosseinpour R, Yavari Barhaghtalab MJ. Isolated comminuted fracture of the cricoid cartilage and narrowing of the airway after a traumatic blunt injury of the neck: a case report. Int J Emerg Med. 2022;15(1):55. [CrossRef]

8. Lin HL, Kuo LC, Chen CW, Cheng YC, Lee WC. Neck hyperflexion causing isolated thyroid cartilage fracture-a case report. Am J Emerg Med. 2008;26(9):1064.e1-3. [CrossRef]

9. Schaefer N, Griffin A, Gerhardy B, Gochee P. Early recognition and management of laryngeal fracture: a case report. Ochsner J. 2014;14(2):264-5.

10. Fuhrman GM, Stieg FH 3rd, Buerk CA. Blunt laryngeal trauma: classification and management protocol. J Trauma. 1990;30(1):87-92. [CrossRef]

11. Schaefer SD. The Acute Management of External Laryngeal Trauma: A 27-Year Experience. Arch Otolaryngol Head Neck Surg. 1992;118(6):598-604. [CrossRef]