

— Case report —

## Traumatic asphyxia death in a bicyclist: an autopsy case

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**Abstract:** We report an autopsy case of fatal traumatic asphyxia in a bicyclist. A 15-year-old female bicyclist fell from her bike after collision with the rear end of a truck that was backing up. Her body was pinned between the ground and a spare tire attached to the bottom of the truck. Autopsy revealed congestion of the head, face, neck, upper anterior aspect of the chest, and bilateral arms, and many petechial hemorrhages in the oral mucosa and bilateral palpebral conjunctivae. Internal examination revealed hemorrhage of the intercostal muscles with a rib fracture, mild liver laceration, and pelvic fracture resulting from compression of the thoracoabdominal region, and the findings of acute death. The cause of death was diagnosed as traumatic asphyxia. Known mechanisms of traumatic asphyxia in motor vehicle collisions include crushing of pedestrians or ejected occupants by the vehicle and crushing of occupants by intrusion into the passenger compartment; traumatic asphyxia resulting from vehicle collision involving in a bicyclist has not been reported. The present case indicates that forensic pathologists should consider the possibility of traumatic asphyxia when investigating vehicle collision deaths, especially in bicyclists.

**Keyword:** Traumatic asphyxia, bicyclist, vehicle collision, autopsy

### 1. Introduction

Traumatic asphyxia (TASP) indicates compression and immobilization of both the thorax and abdomen for an indeterminate length of time until respiration ceases or become inefficacious [1,2]. The typical pathological features of TASP are purple craniofacial congestion with petechial hemorrhages of the face, neck, upper chest, and conjunctivae [3]. Although TASP is considered a rare cause of death, it can occur in a variety of situations, such as building collapse, motor vehicle collision, and compression by construction equipment. According to a study by the Office of the Medical Examiner in Miami, the incidence of TASP was 0.36% among all fatalities [4]. The most common cause of TASP is motor vehicle collision [5]. Known mechanisms of injury in TASP resulting from motor vehicle collision include crushing of pedestrians and ejected occupants by the vehicle and vehicular space intrusion; collision-related TASP in bicyclists has not been reported [1-8]. We report the mechanism of fatal TASP in a bicyclist in this rare autopsy case.

### 2. Accident

The accident occurred at 5:30 p.m. The driver of a truck with a maximum load weight of 12,500 kg was driving in

reverse at approximately 5 km/h. At the same time, a healthy 15-year-old female bicyclist was riding on the sidewalk behind the truck. The truck collided with the teen, who fell from her bicycle and was pinned under the truck between the ground and a spare tire attached to the bottom of the truck body at 32 cm above the ground (Figure 1).



Figure 1. Side view of the truck.

After parking, the driver left the truck without noticing the bicyclist. The driver drove off the next day at 3:00 a.m., still unaware that the bicyclist was pinned under the truck. The bicyclist was found dead at 7:25 a.m. To determine the mechanisms and cause of death, forensic autopsy was performed 6 hours after the body was discovered.

### 3. Autopsy Findings

The teen's height was 156.5 cm and her weight was 50.0 kg. Purple-red congestion was observed on the head, face, neck, upper anterior aspect of the chest, and bilateral arms. Many petechial hemorrhages were seen in the oral mucosa and bilateral palpebral conjunctivae. In addition, a palm-sized dark reddish-brown area was present on the left side of the head. There were round marks on the abdomen, which corresponded to the spare tire (Figure 2). Dark reddish-brown abrasions and green-to-brown skin regions were found on the inner left thigh and front and inner left lower leg.

Internally, marked subcutaneous petechial hemorrhages were observed in the head. Subcutaneous and temporal muscle hemorrhages were present on the left side of the head. Neither skull fracture nor cerebral damage was observed. Intercostal muscle hemorrhage was present from the left second to fifth ribs and the right fifth to seventh ribs, with right eighth rib fracture (Figure 3). A small amount of dark red fluid blood was observed in the heart cavities. No injuries or abnormalities were found in the intrathoracic organs. A laceration 3.0 cm long and 1.3 cm deep was observed in the liver. The left pubic bone was fractured, and the left sacroiliac articulation and pubic symphysis were dislocated, with hemorrhage in the surrounding area. Petechial hemorrhages were observed in the mucosa of the left renal pelvis. Subcutaneous hemorrhages were found in the bilateral inner lower extremities, corresponding to the injuries found externally; decollement injuries were present in the left leg.



Figure 2. External findings of the bicyclist.

### 4. Diagnosis of Cause of Death

The autopsy revealed dark-red congestion of the head, face, neck, upper anterior aspect of the chest, and bilateral arms. The features of the injuries in the pelvis and lower extremities suggested compression of the lumbar region and lower extremities. The tire marks on the upper abdomen indicated that her chest and abdomen were strongly compressed by the spare tire.

Hemorrhages of the intercostal muscles with rib fracture and mild liver laceration were present, resulting from compression of the thoracoabdominal region. These injury severities were relatively minor and could not be the cause of her death.

Multiple petechial hemorrhages were observed in the conjunctiva, oral mucosa, and mucosa of the left renal pelvis. The fluid blood in the heart and visceral congestion were also observed, and these findings suggested acute death.

Because of these findings and the collision situation, the cause of death was diagnosed as TASP, with acute respiratory inefficacious due to the strong compression of her thorax and abdomen.

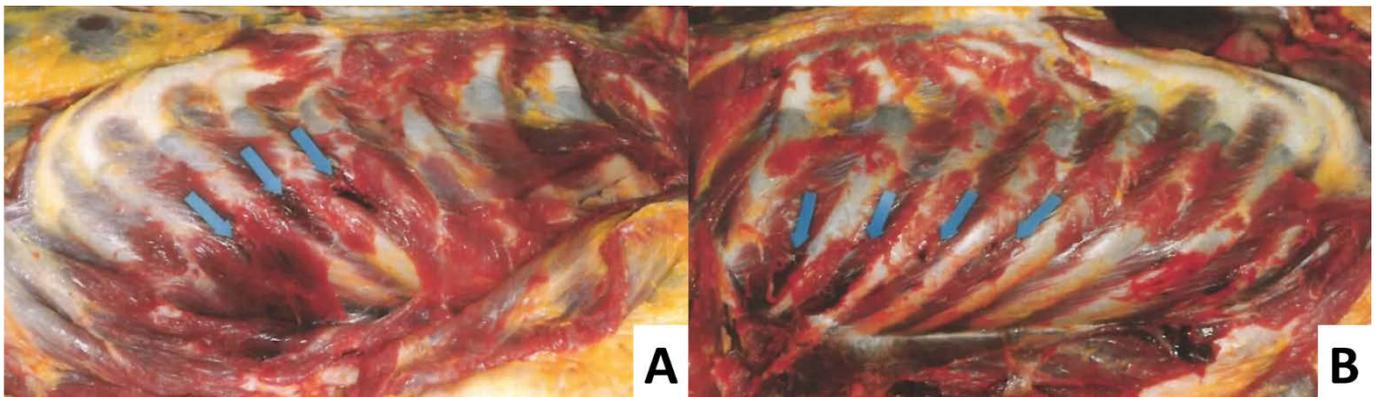


Figure 3. Hemorrhage in left (A) and right (B) intercostal muscles.

## 5. Discussion

To our knowledge, this is the first autopsy report of death from TASP in a bicyclist in the English-language literature. TASP from motor vehicle collisions has been described. Conroy examined 37 motor vehicle-related asphyxia deaths and reported 18 cases of traumatic asphyxia, all in vehicle passengers or drivers [6]. Byard reported 37 TASP deaths related to vehicle collisions [3]. Most of those deaths resulted from vehicle occupants being pinned beneath their own vehicles after a rollover accident or from compression within the vehicle cabin resulting from collision. Sklar reported 14 fatal and nonfatal TASP cases involving moving motor vehicles [7]. Nine victims were crushed by their own vehicles after ejection and three were compressed between the steering wheel or dashboard and the seat. One child was crushed by the wheel of a vehicle moving at low velocity while she played behind the vehicle. Other case reports have described motor vehicle collision-related TASP in a pedestrian hit and run over by a vehicle, vehicle occupants crushed by the vehicle after ejection, or vehicle passengers compressed in the vehicle after collision [1-8]. Only one case of TASP in a motorcyclist has been reported [5]. A 36-year-old motorcyclist ended up under a bus in a collision; when the drive shaft of the bus rotated, it pulled and crushed the man between the body of the bus and the drive shaft. However, detailed information about the collision mechanism was not described in that report. Until now, no fatal TASP resulting from motor vehicle collision has been reported in a bicyclist.

In this case, a bicyclist collided with a large truck, fell to the ground, and was run over. Her chest was pinned between the ground and a spare tire attached to the bottom of the truck body. TASP injuries commonly include pulmonary contusion, hemothorax, and pneumothorax. These concomitant injuries may be useful markers for the severity of compression. However, in this case, because the teen had one rib fracture and no visceral injuries, her death might have resulted from the extent and duration of compression. If the driver had noticed the bicyclist and immediately rescued her, her death might have been avoided. One study reported that TASP develops over a 2-to-5-minute compression period [9].

The situation that led to the unhappy outcome described in this case is rare. However, similar cases can occur under

certain conditions. When a large vehicle moves in reverse, the visibility of the driver is generally poor. In low-speed collision between a bicyclist and a vehicle, the bicyclist can easily fall forward and be run over. The bottom of a heavy vehicle is high enough that a person can easily enter the space between the bottom of the vehicle and the ground. Therefore, to prevent similar fatalities, safety equipment, such as a rear monitoring system that warns of objects beneath the vehicle, is needed. The diagnosis of TASP will elucidate high risk collision situations, as in her case, and in future, might lead to the prevention of future traffic injuries and deaths.

As shown in the present case, forensic pathologists should consider the possibility of TASP when investigating vehicle collision deaths, especially in bicyclists. The signs of TASP, which include facial color change and edema and subconjunctival hemorrhage, should be carefully examined, in addition to the survey of bodily injuries.

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## 外傷性窒息により死亡した自転車乗員の解剖検例

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**和文抄録：** 外傷性窒息により死亡した自転車乗員の剖検事例を報告する。症例は15歳の女子，自転車に乗車し空き地を走行中，空き地に駐車するため後進する大型トラックの後部と衝突した。死者は自転車から転落し，地面と大型トラックの底面に取り付けられたスペアタイヤの間に挟まれ死亡した。翌日司法解剖が施行された。外表所見では，頭部，顔面，頸部，胸部上前面，両上肢にうっ血と，左右眼瞼結膜下及び口腔粘膜下に多数の溢血点を認めた。内景所見では，急死の所見，左第2から第5肋骨及び右第5から第7肋骨の骨折，軽度の肝挫傷，胸腹部圧迫による骨盤骨折を認め，死因は外傷性窒息と診断した。自動車衝突事故における外傷性窒息では，歩行者や車外放出された乗員の車両底面による圧迫，車両の陥凹に伴う乗員の圧迫などが知られているが，自転車乗員の車両衝突事故による外傷性窒息は報告されていない。本事例は，自転車乗員の衝突事故死例を経験した際に，外傷性窒息の可能性を検討すべきことを示唆している。

**キーワード：** 外傷性窒息，自転車乗員，交通事故，法医解剖