



# Case #141

NAME Educational Activities Committee

Case provided by:

Dr. Hind ABOUZAHIR, MD, PhD

Medical Examiner / Associate Professor

Medicolegal Institute, Ibn Rochd University Hospital, Casablanca Morocco

Dr. Barthelemy Munkana Matadi,

Resident Doctor

Medicolegal Institute, Ibn Rochd University Hospital, Casablanca Morocco



A 51-year-old male driver, the sole occupant of the vehicle, was pronounced dead at the scene after his car struck a palm tree at an intersection while apparently attempting to avoid an obstacle. According to the police report, the vehicle sustained marked frontal damage with deployment of the driver's airbag. The vehicle cabin was intact, with no evidence of shattered glass or open access points, and no weapons were found at the scene.

External examination revealed a single, well-circumscribed penetrating wound in the right suprasternal region, measuring approximately 4 × 4 cm, with darkened margins and without soot deposition or stippling. No additional penetrating injuries were identified, and there was no exit wound.

Dissection of the wound tract revealed a metallic object. The object was cylindrical, metallic, oxidized, and had irregular, jagged edges.

**Based on the autopsy findings and the recovered object, which of the following best explains the mechanism of injury?**

- A. Gunshot wound from a projectile fired through the vehicle window.**
- B. Penetrating wound from a sharp object inside the vehicle.**
- C. Penetrating wound from roadway debris entering the vehicle during impact.**
- D. Penetrating wound from fragments of an internal vehicle safety device.**

Correct Answer...

## **D. Penetrating wound from fragments of an internal vehicle safety device (Correct answer - 77.46%)**

Defective airbag inflators, particularly those containing aging or unstable ammonium nitrate propellant (see Figure 4), can catastrophically rupture during deployment. Inflator over-pressurization leads to structural failure of the metal inflator canister, causing it to fragment explosively and eject high-velocity metallic shards into the vehicle cabin.

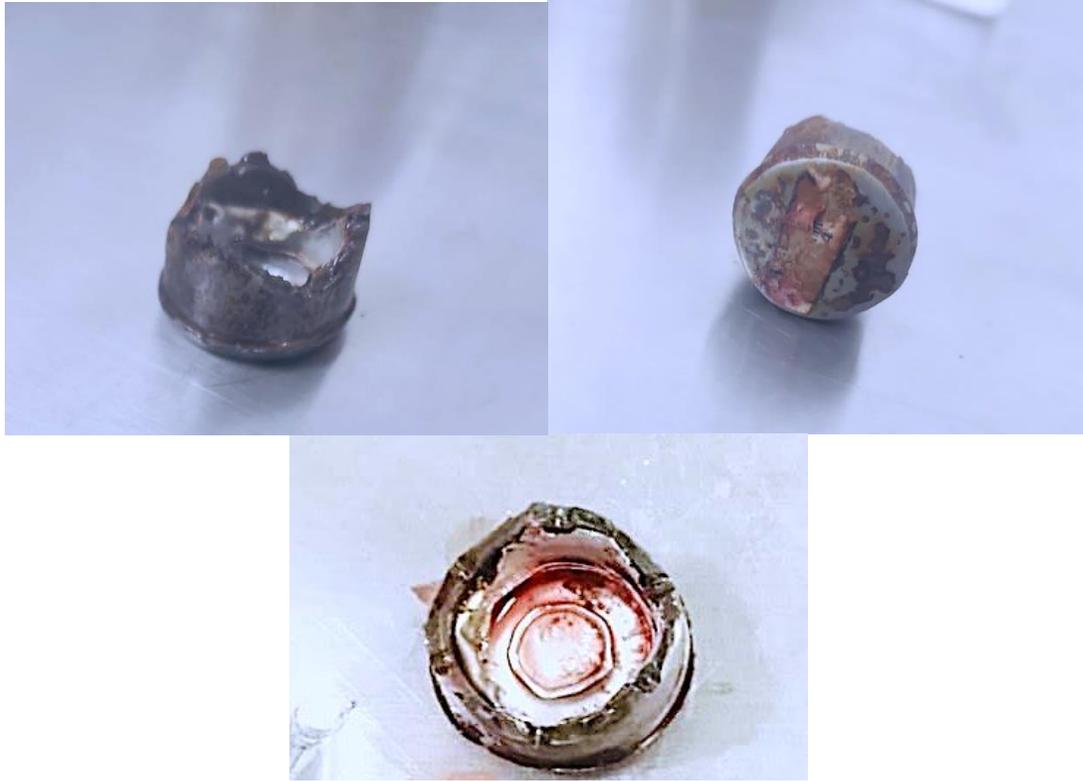
These fragments behave as pseudo-ballistic projectiles and are capable of producing fatal penetrating injuries. From a structural standpoint, inflator rupture results in longitudinal splitting or shattering of the cylindrical metal housing, generating jagged, irregular fragments that may perforate the airbag fabric itself and strike the occupant directly.<sup>2,5</sup>

The U.S. National Highway Traffic Safety Administration has reported multiple confirmed deaths and hundreds of severe injuries caused by metal shards expelled by ruptured airbag inflators<sup>1</sup>. These cases have been directly linked to inflator over-pressurization and propellant degradation, particularly in older vehicles or those exposed to prolonged heat and humidity. Consistent with this, Khoschnau et al.<sup>2</sup> described six forensic cases of penetrating trauma caused by inflator component failure, with metallic foreign bodies recovered from the neck, mandible, and chest. Fragment sizes ranged from 2 to 2.5 cm, acting as high-velocity projectiles and producing firearm-like injuries. Two patients died, while others sustained severe complications including mandibular fractures, hemothorax, and lung lacerations. Additional forensic reports describe similar mechanisms, including fatal carotid and jugular vessel laceration caused by semi-cylindrical inflator fragments<sup>3</sup> and cervical penetration by debris described as having “shot like a bullet”<sup>4</sup>.

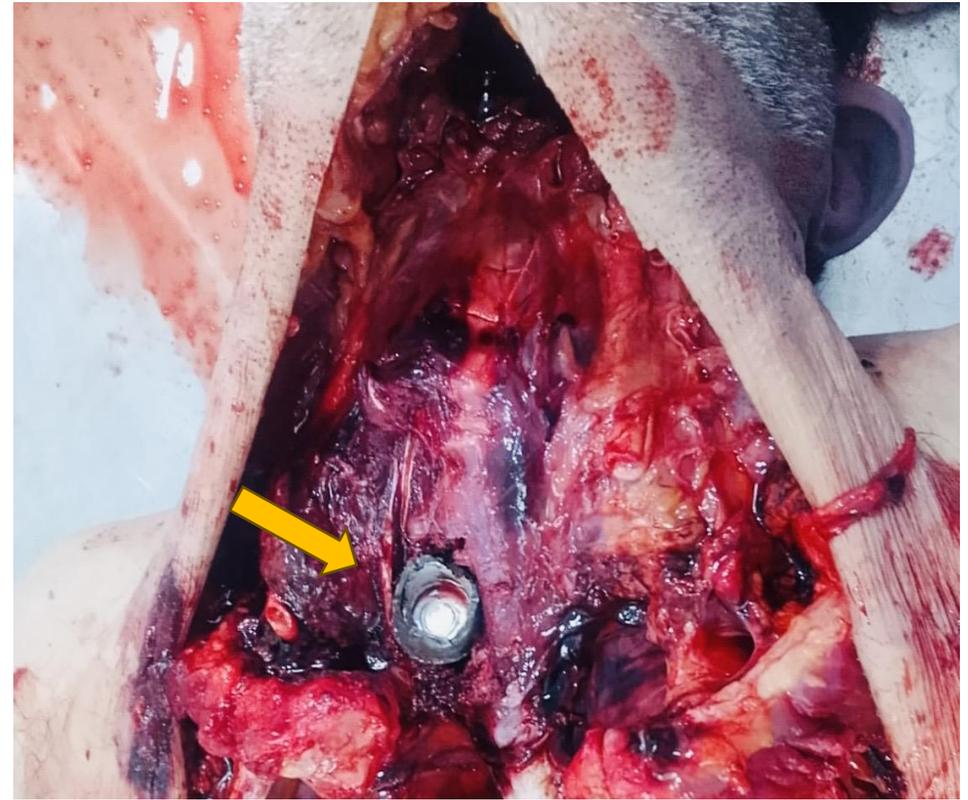
Unlike conventional blunt airbag injuries, inflator ruptures generate sharp metallic projectiles with sufficient kinetic energy to penetrate skin, soft tissues, major vessels, and even bone—producing wounds that can closely mimic gunshot or stab injuries despite the absence of any external weapon (see Figures 5 and 6).

In the present case, the single, well-circumscribed suprasternal penetrating wound, absence of an exit wound, and recovery of a cylindrical, oxidized, jagged metallic fragment are characteristic of inflator shrapnel rather than external trauma. The intact vehicle cabin, absence of shattered glass, and lack of weapons further exclude alternative mechanisms. The injury location, adjacent to major cervical and mediastinal structures, supports a fatal penetrating mechanism caused by inflator-derived metal fragments.

Taken together, the structural failure of the inflator, the projectile behavior of its fragments, and the wound morphology form a coherent and well-documented causal chain. Accordingly, the most medically and forensically consistent explanation is fatal penetrating trauma caused by fragments of an internal vehicle safety device, specifically a ruptured airbag inflator.

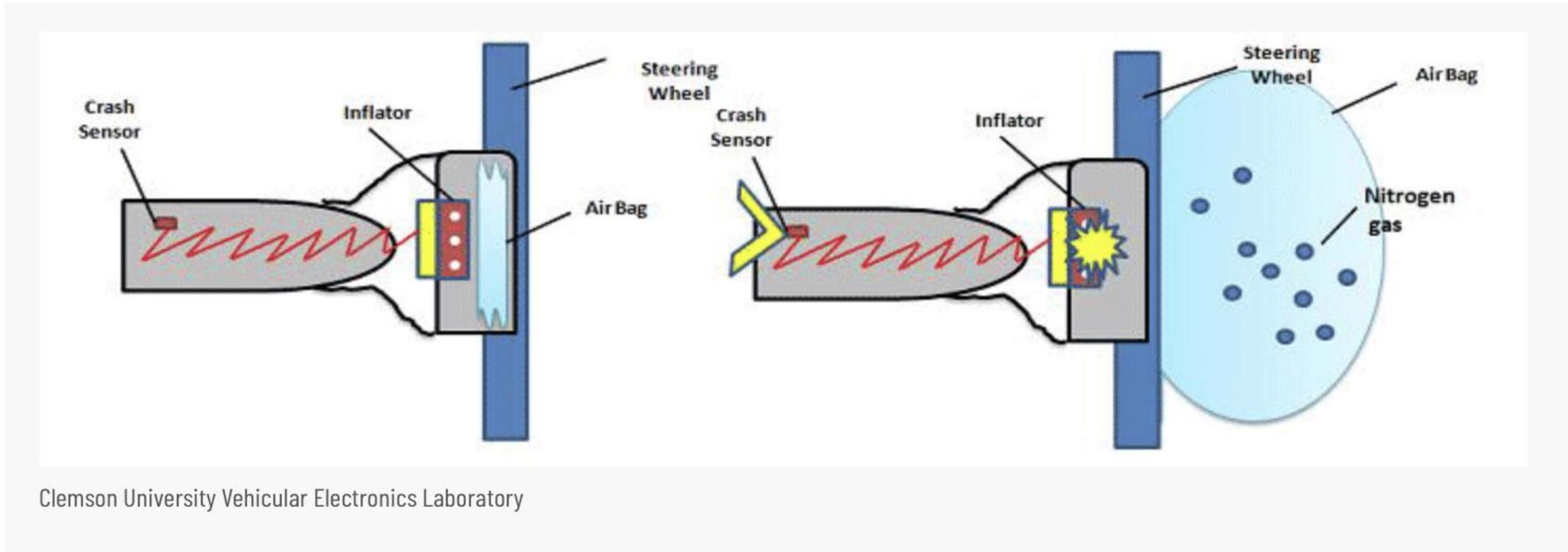


**Figure 3. The recovered Metallic object**



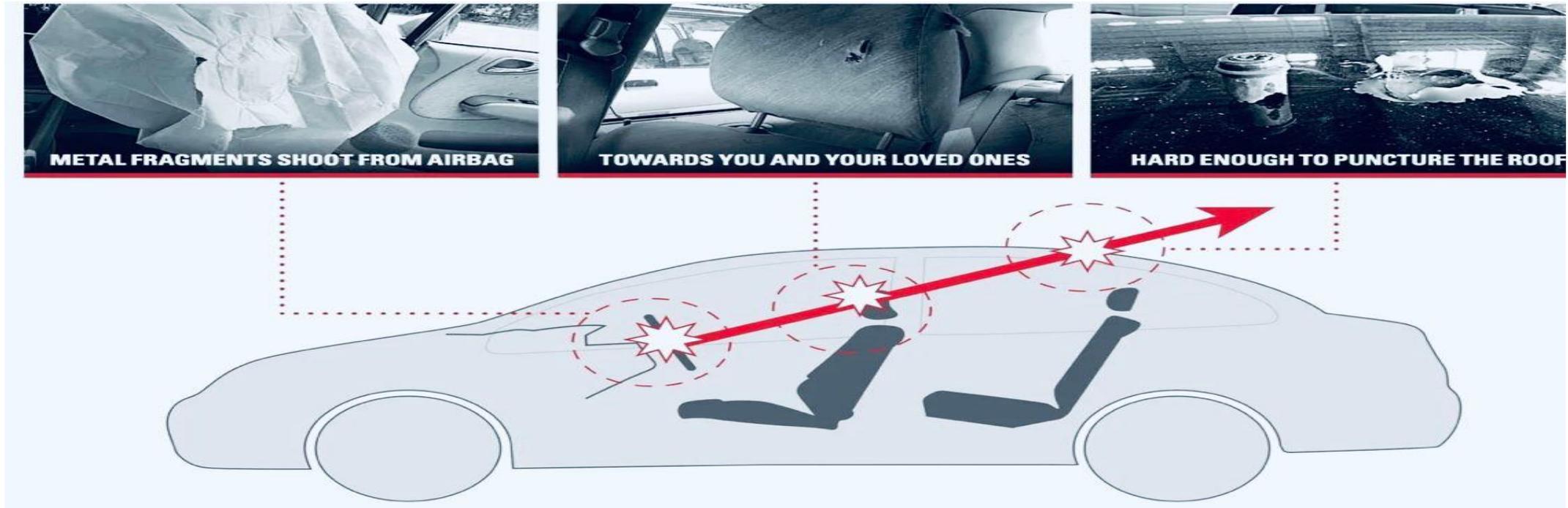
**Figure 2: Metallic object located in the right anterior lower neck, just superior to the sternum and lateral to the cervical spine**

**Additional photographs from the autopsy of the deceased at the Medico-Legal Institute in Casablanca, Morocco.**



Clemson University Vehicular Electronics Laboratory

Figure 4. Components of airbag  
(source: <https://www.popsci.com/how-airbags-are-supposed-to-work/> accessed on 15 December 2025).



**Figure 5:**

**\*Left Panel:** Deployed airbag with documented case of inflator rupture; internal metal components are known to pierce through the airbag fabric.

**\*Center Panel:** Example of driver-side airbag fragment perforation; high-velocity shards can strike the face, neck, or chest of the occupant.

**\*Right Panel:** Metal fragments from ruptured inflators can be forceful enough to penetrate the vehicle cabin and even exit the roof.



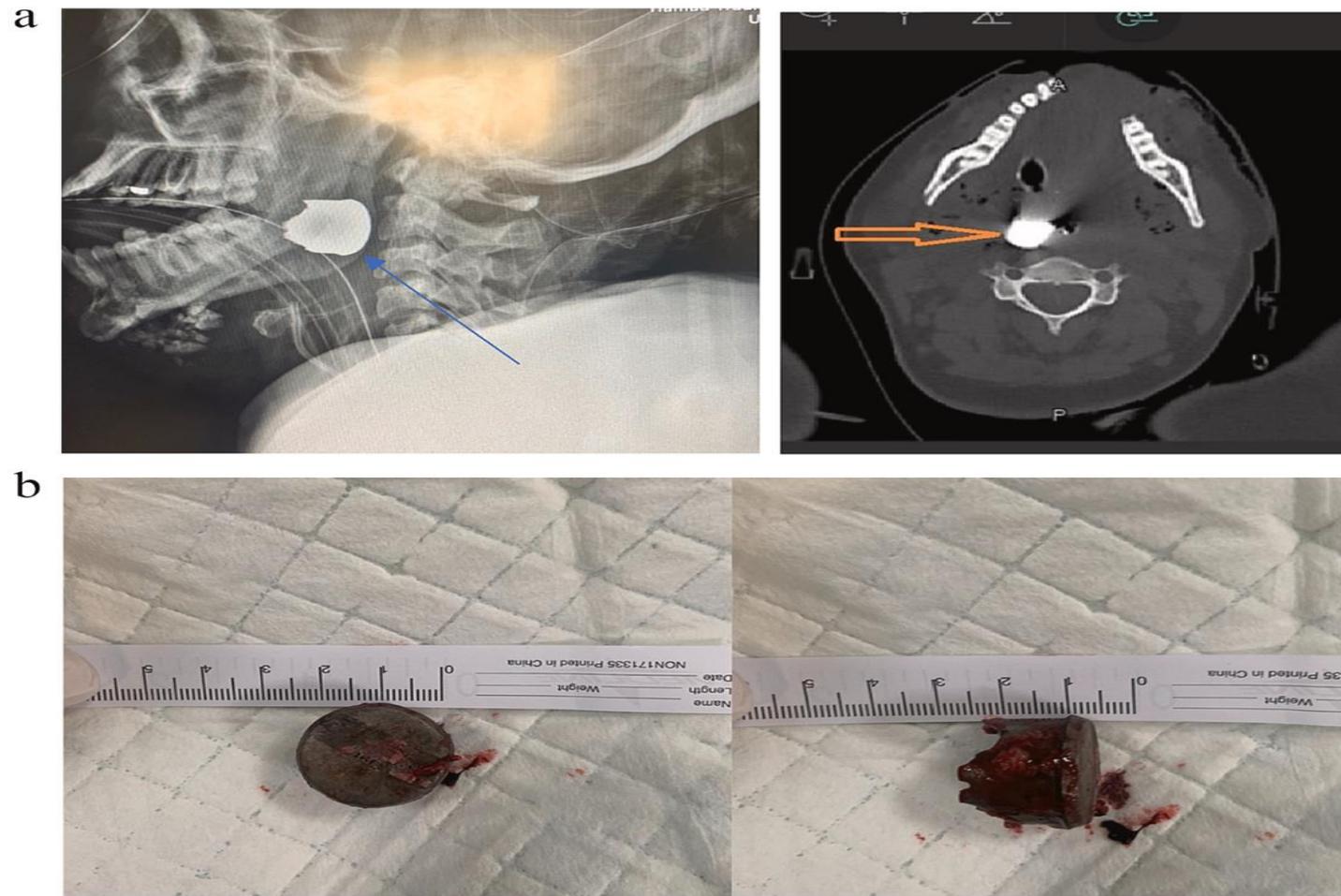
**\*Steering wheel module with opened airbag inflator unit; the central metal housing shown is the component known to rupture explosively in defective systems**



**\*\*Recovered metallic fragment from the wound tract; cylindrical, oxidized, and irregularly fractured, consistent with airbag inflator shrapnel**

*\*TF1 Info. (2025, June 17). Takata airbags: Hundreds of thousands of vehicles immobilized in France. TF1 Info– JT 20h. <https://www.tflinfo.fr/transports/videos/video-airbags-takata-des-centaines-de-milliers-de-vehicules-immobilises-en-france-88133-2377618.html>. (Accessed December 15, 2025)*

*\*\*Garnier, R. (2024, July 11). Another death following the explosion of a defective airbag. France-Guyane. <https://www.franceguyane.fr/actualite/faitsdivers/un-nouveau-deces-a-la-suite-de-lexplosion-dun-airbag-defectueux-995150.php>. (Accessed December 15, 2025).*



**Fig. 6.** a: Imaging for case 4: arrows show the projectile airbag component. b: The projectile airbag component.

Khoschnau, A., Yacoub, A., Elserafi, S., Al-Thani, H., & Mekkodathil, A. (2023). Penetrating injuries caused by metallic fragments from airbag inflators: A forensic case series and review. *Trauma Case Reports*, 47, 100853. <https://doi.org/10.1016/j.tcr.2023.100853>.

Other responses...

## **A. Gunshot wound from a projectile fired through the vehicle window (incorrect answer – 4.23 %)**

A firearm-related penetrating injury is unlikely in this case based on both wound characteristics and the nature of the recovered object. Gunshot wounds typically demonstrate associated ballistic features that vary with firing distance, including soot deposition, powder stippling (tattooing), or muzzle imprinting in close- and intermediate-range shots. Even in distant-range gunfire, ballistic wounds usually show a more regular entrance morphology and are commonly associated with the recovery of a bullet or bullet fragments with characteristic smooth or deformed lead or jacketed metal surfaces<sup>6</sup>.

In the present case, the wound margins were darkened but showed no soot deposition or stippling, arguing against a close- or intermediate-range firearm discharge. Furthermore, the recovered foreign body was described as cylindrical, oxidized, and irregularly jagged, which is morphologically inconsistent with a typical firearm projectile. Bullets are usually composed of lead or jacketed metal and exhibit deformation patterns such as mushrooming or fragmentation, rather than irregular, oxidized shrapnel-like edges<sup>6</sup>.

Additionally, firearm injuries generally follow a predictable ballistic trajectory and are often associated with an exit wound or retained bullet of recognizable ballistic form<sup>6</sup>. The absence of an exit wound, the lack of scene evidence suggestive of gunfire, and the atypical appearance of the recovered metallic object collectively argue against a firearm-related mechanism. Instead, these findings are more consistent with a pseudo-ballistic injury caused by high-velocity metallic fragments originating from within the vehicle, such as those produced by airbag inflator rupture.

## **B. Penetrating wound from a sharp object inside the vehicle. (incorrect answer – 11.03 %)**

A true stab wound caused by a knife or glass typically features: Clean linear entry, often without metallic residue, Evidence of a sharp-edged instrument, Laceration rather than avulsion or fragmentation in tissue.

In airbag injury cases, these criteria were unmet: No knife, broken glass, or sharp object was found in any vehicle cabin. Fragments recovered were jagged metal pieces with oxidized edges, not blade-like.

The wound margins in these cases were often circular or stellate, inconsistent with traditional stab wounds.

In the Khoschnau et al<sup>2</sup> case series, none of the six victims had trauma consistent with blade entry; instead, retained metal fragments were traced to the inflator module.

In conclusion: the depth and shape of injuries mimic stab wounds only superficially. True stab wounds leave different wound tracks and involve identifiable external implements, which were absent in every reported verified case in the literature.

## **C. Penetrating wound from roadway debris entering the vehicle during impact. (incorrect answer – 7.28 %)**

Penetration by external roadway debris (e.g. rocks, glass, signage) is rare and unlikely due to:

- Car cabin protection: windshields, airbags, and dashboards serve as significant physical barriers.
- No evidence of shattered glass or open access points (like a broken window or missing roof).
- Projectile velocity from road debris is generally insufficient to cause deep, localized neck or thoracic penetrations.

By contrast: In all airbag rupture cases, metallic debris originated from within the cabin. The Trauma Case Reports<sup>2</sup> noted projectile force was strong enough to tear seatbelts and puncture chests, something no passive road debris could accomplish.

In summary, no documented case supports a penetrating neck wound from external road debris without other accompanying damage. Internal inflator shrapnel is the only proven source in such pseudo-ballistic trauma.

# REFERENCES

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