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Case Series

Positional asphyxia: Potpourri of cases

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ABSTRACT

A legal medicine specialist will likely be able to observe a variety of situations in which positional asphyxia, a deadly condition resulting from the adoption of specific body positions that cause mechanical interference with pulmonary ventilation, can occur (work, car accidents, torture, kidnapping, etc.). In these circumstances the cause of death is typically difficult to determine because the patient typically presents with a distinct anatomo-pathologic appearance.

Because of chest compression, positional asphyxia can occasionally be difficult to differentiate from asphyxia. The primary distinction is in how the incident happened: that is, if the specific posture that resulted in asphyxia was acquired voluntarily or was due to an external mechanical action that led to traumatic asphyxia.

Three basic criteria are used to diagnose positional asphyxia: the body posture must impede normal gas exchange [1], moving to a different position must be impossible, and alternative cause of natural or violent death must be ruled out. The authors here present a series of five cases drawn from the professional experience to highlight the primary patho-physiologic and diagnostic causes of positional asphyxia.

1. Introduction

A type of mechanical asphyxia known as positional (postural) asphyxia happens when a person is immobilised in a position that hinders sufficient pulmonary ventilation, leading to respiratory failure. [1] In certain situations, the body position directly impedes normal gas exchange, contributing to the obstruction. Although this type of asphyxia is typically unintentional, it has also been connected to murder and torture. [2] The literature that is now accessible indicates that positional asphyxia can result from a variety of various positions and postures. As such, a consistent strategy is challenging. For example, in reverse suspension during adventure sports or accidents, the head down position may occur. [3] The same effect might happen in other situations, as during surgical procedures where the Trendelenburg position is necessary. The potential detrimental effects of the position on cerebral and coronary circulation as well as on breathing are taken into consideration in the literature; these changes are especially pronounced in obese, aged, or disabled patients.

Other possible underlying causes of death, such as trauma, drunkenness, tiredness, hyperthermia, mental illness or crush syndrome, should not be disregarded and must be ruled out first, even in the midst of compromising posture. Different authors have given different criteria to assist distinguish these instances. Lastly, instances of positional asphyxia involve people who fall into small areas and are unable to escape. Differentiating between positional asphyxia and traumatic asphyxia by compression might be challenging in these situations.

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Traumatic asphyxia, defined as "the compression and immobilisation of the thorax or of the thorax and abdomen together, for an indeterminate length of time, until respiration ceases or becomes inefficacious," was first studied in the 19th century by Ollivier and Tardieu.[4,5] Carrara et al.[6] have defined this term. The phenomenon known as "indirect suffocation" was first described by Borri et al.[7] as occurring when "a peripheral obstacle which hinders its function reduces the rib cage to a state of inertia". However, they made no mention of positional asphyxia specifically.

Examples of positional asphyxia in the broad sense include complex scenarios where it is challenging, if not impossible, to pinpoint the exact manner of asphyxiation. Some incidents are under the purview of forensic medicine, such as workplace mishaps, athletic mishaps, and torture- or kidnapping-related deaths. Because the anatomic-pathologic signs are infrequent and nonspecific, it might be challenging to determine the cause of death in these situations.

Discussed here are five cases reported at various hospitals across National Capital Region (NCR) region over last few years. The main diagnostic and pathophysiologic aspects of positional asphyxia are outlined, and the criteria for including complex mechanical modes of asphyxiation are discussed.

2. Case Series

2.1. Case 1

In a building's basement stairwell, a 47-year-old man passed away. The night before, he had been drinking with his colleagues. According to the security camera, he sent his colleagues before entering the premises around 00:45 am. The body was discovered in jack knife and inverted position. The deceased must have flexed his neck and torso excessively (Figure 1). There was a puddle of blood surrounding his head. At 9:10 am, the security found the deceased. Surveillance camera recording was seen but no suspicious individual was found in camera upto this time. During the post-mortem assessment, positional asphyxia from falling was found to be the cause of death.

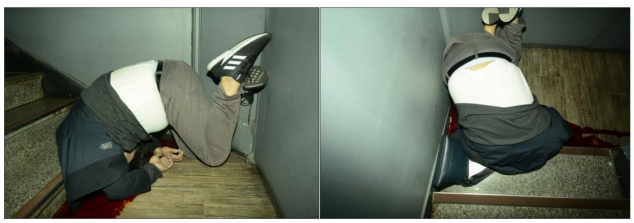

Figure 1: Image showing the body in Jack-knife & inverted position

During autopsy, the deceased was found to have 110 kg weight and 183 cm height. Upon external inspection, lacerated wound of size 6.5 cm x 0.5 cm was present on left temporal region. Conjunctival petechiae and facial congestion were noted. Both legs had minor bruises and abrasions. Vomitus was seen in the trachea, oesophagus, bronchus, and nasopharyngeal region in minor amounts. There was evidence of fatty liver and cardiomegaly (600 g). The level of ethanol in the blood was 0.201%. Studies on toxicology were negative otherwise. The deceased's position prevented proper respiration. The security camera footage shows that no one else disturbed his position for 8.5 hours.

Petechiae and facial congestion were noted as signs of hypoxia. As a result, positional asphyxia may be identified. One could infer the cause of death based on the deceased's position. His blood alcohol content of 0.201% may have contributed to an unsteady gait, which may have caused him to lose equilibrium and fall onto his back while ascending the stairway. After falling backward, his lower body might have been caught in a jackknife position due to inertia. The inebriated condition and the accident prevented the movement and this position was sustained for prolonged duration.

2.2. Case 2

A 26-year-old male young adult was discovered dead in an unusual position in a ditch near to the road. After examining the deceased person's body, investigating agencies had concerns due to the deceased's criminal history and the unusual position (Figure 2). On visiting the scene of incident, an adult male's lifeless body, which had not been moved, was discovered (Figures 1 and 2). According to the deceased's relatives, the man was in good health and did not suffer from any serious illnesses.

Figure 2: Image showing dead body of a male in an unusual position

With the exception of a little tear across the left axillary area of the T-shirt, every article of clothing on the body was intact. A partially depleted whisky bottle was discovered in the undergarment pocket, and an empty plastic bottle next to the body. There were no indications of any disruption in the vicinity. The oral and facial mucosa were observed to be swollen. Several petechial haemorrhages were noticed in the conjunctiva with bluish discoloration on

the fingernail beds. There was post mortem lividity on the body's upper portion. The body was covered in rigor mortis.

During autopsy, upon closer inspection, the body appeared to be reasonably well-fed and built. Clothing was soiled with mud and free from bloodstains or vomitus. There were no visible wounds on the body of deceased. Upon internal inspection, there were numerous petechial haemorrhages in the white matter and an oedematous brain. Frothy fluid was found in the bronchi, bronchioles, and tracheal lumen. There was oedema and congestion in both lungs. The coronaries on the histology study revealed no microscopic abnormalities, and the heart was in good condition. Rest other internal organs were swollen. No abnormalities were discovered in the spine and neck tissues. To rule out poisoning or other substance abuse, viscera were sent for qualitative and quantitative chemical analysis.

Ethanol was detected in qualitative examination of stomach contents, and 220 mg% of blood alcohol was detected in quantitative analysis test on blood. Using standard procedures, toxicological testing for drugs of abuse produced negative results.

2.3. Case 3

A 30-year-old man inside the mechanical digger died, when the machine he was operating plunged over the cliff and into the quarry (Figure 3). Due to the challenges posed by the vehicle's situation, the body's recovery took a lengthy time. Twenty minutes later a doctor certified death. Following the collision, the body was still imprisoned inside the car, laying on its back with its head turned towards the bottom of the quarry.

Upon external examination, there was bilateral conjunctival and localised hypostasis on the face, neck, and upper chest, along with fine cutaneous petechiae in these areas. The scalp, left eyebrow, left deltoid, left portion of the chest, both forearms, right elbow, hands, and legs all have minor wounds. The tongue had been chewed off, severing the third distal area.

A closer look revealed blood congestion around the base of the tongue, the epiglottis, and the trachea in addition to a minor haemorrhagic infiltrate around the lesions seen during the exterior examination. The leptomeninges and white material in the brain were significantly congested; the lungs were heavy and dark red, and frothy reddish liquid emerged when the lung tissue was cut. There were no fractures and the samples from the remaining organs were insignificant. The vitreous humor alcohol test came out negative.

The victim's posture after the vehicle flipped over and the amount of time they spent upside down while imprisoned were determined to have contributed to asphyxia, which was the cause of death.

Figure 3: Image showing body of a mechanical digger with machine plunging over the cliff

2.4. Case 4

In a rural area, a 51-year-old man lost his life while using a tractor and trailer. The accident occurred at approximately 3:00 p.m., according to the inquiry records. The deceased disregarded safety precautions and crouched beneath the trailer, where the clothes were pulled in by the rotating shaft, immobilising the subject. The body was discovered at 10:30 p.m. in a semi-kneeling position beneath the trailer with arms extended to the sides.

The corpse was found to be 75 kg in weight and 172 cm in length during the autopsy. Upon external examination, the upper back's loose and elevated clothing was observed. When the clothes were taken off, the shoulders and upper arms showed signs of skin lesions that resembled parchment, abrasions, and subcutaneous haemorrhages. On the rear surface of the left upper arm, there was a crush wound. Every exterior injury that was evident matched the folds and wrinkles on the garment. Upon closer inspection, the body showed indications of an abrupt death. There was obvious cerebral and pulmonary oedema as well as widespread abdominal visceral vascular congestion. Toxicological analysis reports came out to be negative for alcohol or any other common substance of abuse.

Fixed position of thoracic cavity at the back leading to asphyxia, was determined as the cause of death.

2.5. Case 5

The interior sliding security door of the security van caught a 45-year-old guy who was a guard inside, for an unknown duration—at least a few minutes—between it and the door frame (Figure 4). After being freed by his colleagues, he was rushed right away to the emergency room, where he was found to be in a state of cardiac arrest, lacking any reflexes (deep or superficial), as well as having ecchymosis of the neck, upper chest, right armpit, and forearm.

After five minutes, the patient got both mechanical and electrical cardiac stimulation in addition to being intubated and receiving external heart massage. In addition to medicines, assisted ventilation was set up with oxygen saturation at 100%. Bilateral dilatation of pupil and lack of reflexes persisted. The results of the neurologic examination showed widespread cerebral oedema and evidence of cerebral venous stasis in the CT scan, indicating anoxic ischemic encephalopathy caused by circulatory derangement. The neurologic state worsened over the next few days, and after a week, an irreversible coma was declared and the patient passed away.

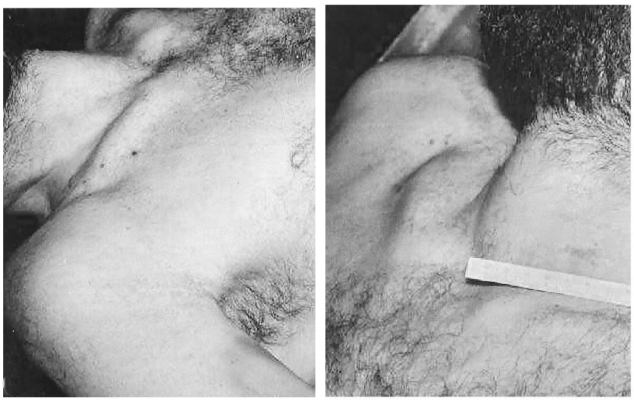

Figure 4: Image of body of a guard, who got caught inside the interior sliding security door of a van

Internal examination during the autopsy identified four parallel abrasions, the largest of which was located proximally (8 cm long), while the others measured 3 cm each. In the left sternocleidomastoid region, there was a linear abrasion measuring 6 cm in length. Above a greenish-yellow patch of ecchymosis, in the left subclavicular region, was a rounded abrasion with a maximum diameter of 2 cm. There were abrasions in the right armpit and petechiae in the upper arms and right chest area. Examining the meninges and brain revealed abundant dark fluid blood in the superior sagittal sinus, congested leptomeninges, cerebral oedema, and infection in the deep level of the scalp and right occipital bone.

There was deep bleeding in the soft tissue of the left periclavicle and the tongue muscles. There were fractures of the right ribs II, III, and IV along the midclavicular line.All organ and visceral samples were negative for any major findings.

3. Discussion

Complex mechanisms of mechanical asphyxiation, in which multiple variables may have interfered with normal pulmonary breathing, were the cause of the five cases documented here. The term was initially used by Bell et al.[8] who also proposed a number of criteria to settle complex diagnosis. Most authors still depend on the primary assessments, despite the fact that several of the criteria have been contested[9]

The following can be used to summarise these requirements: 1) A negative autopsy or little asphyxial symptoms. 2) The way the body is positioned needs to obstruct regular gas exchange. 3) The person cannot possibly relocate to another location. 4) Any other causes of death, whether natural or not, need to be ruled out.

Out of all cases reported, three instance most definitely falls under the category of positional asphyxia, which can be caused by one of two mechanisms: by the body being upside-down, or being trapped in the cabin of an overturned vehicle. One common, albeit uncommon, scenario in which a person dies from a body posture is when they are head-down. Madea[10] has described two lethal processes—inadequate circulation and asphyxiation due to thoracic obstruction, which restricted thoracic movement—while highlighting two common instances of suspension in the head-down position (Madea's first case,[10] cases reported by Purdue[11] and Marshall[12])

Complex hemodynamic malfunction occurs in these cases due to the following factors: (1) increased hydrostatic pressure in the head, neck, and thorax; (2) blood stasis in body parts where the heart's return blood flow mechanisms are less effective; (3) increased transmural venous pressure in the brain; and (4) increased static pressure in the carotid sinus and decreased arterial pressure. Given the surgical procedures performed in the Trendelenburg position, it is imperative to evaluate the hemodynamic alterations resulting from the head-down posture, especially from a clinical perspective.

According to some authors, one significant factor could potentially be the limitation of thoracic movements which could come from arms hanging freely[13] or muscles tensing up in reaction to suspension. Furthermore, research on animals has demonstrated the substantial effect of the abdominal viscera exerting pressure on the diaphragm as a result of gravity.[14] This, in turn, causes respiratory dysfunction, which is typified by a reduction in total lung volume & gas diffusion[15] and an increase in non-aerated lung volume.

Knight[16] also believes that the compression of the diaphragm by the abdominal viscera is the primary mechanism preventing breathing while the head is down.

Madea[10] stresses the need for a change in breathing patterns, particularly in light of the consequences of lower negative venous pressure. The author arrived to the conclusion that positional asphyxia, which results from respiratory muscle fatigue generated in an attempt to overcome the obstruction to respiratory movement, causes death in the upside-down posture of the body.

Among the additional positions that have been identified, most of them have little to do with body inversions other than respiratory movement obstruction. Aside from the inverted body posture, as seen in Case 3, other circumstances also played a role in the victim's quick demise. One such aspect was being trapped in a restricted space, which is thought to affect respiratory dynamics even when there was no actual thoracic compression'.[17] Apart from the previously described process, hyperflexion or hyperextension of the neck may also cause this to malfunction.

Even though there aren't many examples of positional asphyxia that have been documented, it can be inferred that complicated circumstances typically result in a confluence of different elements that make breathing difficult. Case 5 may be one of these: the victim was undoubtedly imprisoned in a small area, but it makes sense that since he was saved from a life-threatening circumstance and made it to the hospital unharmed, the precise location of the body cannot be inferred from circumstantial evidence.

Aside from head-down positions, which are possibly better studied within a pathophysiologic framework, especially with reference to surgical patients (Trendelenburg),[18] the author believe that this case illustrates how frequently the events causing death are less well-defined.

The only distinguishing factor in these cases is the impossibility of defining a single process of asphyxiation that goes along with anomalous body position. The distinction between positional asphyxia, asphyxia by immobilisation of the thorax, and asphyxia by suffocation is not clearly defined. This impossibility is also present in the contentious "hog-tied restraint," an immobilisation technique that the police department once employed to move people who were under arrest.

These are typical examples, in the forensic expert's opinion, when it is evident[19] how relevant circumstantial evidence is and how important it is to conduct an accurate on-the-spot inquiry. The majority of these instances have autopsy results that are negative or that show only faint symptoms of generic or nonspecific asphyxiation that are compatible with other, even natural, causes of death. In the absence of the aforementioned data, the diagnostic challenges become apparent.

Postmortem exams in the cases reported by Marshall[12], Madea[10] and Purdue[11] mainly turned up nonspecific findings such cerebral congestion and conjunctival congestion and oedema. Because cerebral hypostasis is present in many situations, interpreting these data can be challenging.

The development of petechiae is inversely correlated with arterial compression above the heart and directly proportionate to the extent of vein occlusion. Vein pressure will rise if return flow in the veins to the brain is blocked but not arterial flow; on the other hand, if the force is such that it obstructs arterial flow, there won't be any stoppage of venous flow and concomitant tiny vein rupture.

Haemorrhagic infiltration inside the muscles of the chest and neck is a crucial sign of hypoxia due to blood circulation restriction, particularly when there isn't an outward pathognomonic lesion. Therefore, in the absence of any other particular outward indications, the existence of these haemorrhages is main component in the diagnosis of hypoxia. Muscle haemorrhages, according to Merli,[20] frequently occur in the armpit, upper back, and large pectoral muscles during the convulsive phase of hypoxia.

Numerous risk factors and circumstances that predispose to positional asphyxias have been documented.[21] The most commonly addressed are those that affect normal reflexes and cognitive abilities, such CAD, organic disease, poisoning, or intoxication. Obesity has been described as a significant cause, of being incapable of rising from an inverted position. In total, 10 subjects have been described as being significantly overweight (mean BMI-36.9), 8 0f which were found to be in a head down position.[22–24] Other features commonly distinguished are older age and a strong male predominance. Majority of cases (91%) were deemed to be an accident.

4. Conclusion

In conclusion, it is important to consider positional asphyxia as a cause of death in situations where the following criteria are met: the body's position must impede the regular exchange of respiratory gases; a cause must exist for the impossibility of changing the position; and other possible causes of death, such as natural or violent causes, must be ruled out. In a number of cases where an autopsy yields no meaningful results, positional asphyxia can be the cause of death. It needs to be considered in cases of suspected alcohol or drug abuse-related deaths, in patients suffering from mental illnesses, and in car accidents and workplace mishaps. Additionally, its presence needs to be taken into account in those who are tortured (inverse suspension), as well as in specific cases of surgery (Tredelenburg position). The identification of possible co-factors through profound pathopharmocological and toxicological examination must be done. Examination from forensic medicine point of view must be started at the scene of death along with examination of photos and other evidence.

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None.

6. Conflict of Interest

None.

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