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Suicidal Hanging Resulting in Complete Decapitation—Forensic, Radiological, and Anthropological Studies: A Case Report*

ABSTRACT: The authors report a case of complete posthanging decapitation. The decapitated corpse lay against a pillar of a road bridge. The head had rolled 5 m from the trunk. The bridge was 7.2 m above the road level. The rope was 3.6 m long, its lower end was 3.6 m from the ground and its diameter was 10 mm. The noose used was a slip knot. Plain X-rays of the skull and cervical spine were obtained. The skull X-rays showed air in the meningeal spaces, in both lateral and third ventricles. The severance plane of the cervical spine was between the third and the fourth cervical vertebrae. No other cervical vertebral injuries were noted. At autopsy, the brain was macroscopically unremarkable except for air in the meningeal veins. The decapitation injuries of the head and the torso corresponded perfectly, without apparent loss of substance. The severance plane was confirmed. Dry bone study was carried out. Except for fractures of the extremities of the spinous processes of the second and third cervical vertebrae, no other bone injury of the spine was seen. The cervical vertebrae displayed numerous osteoarthritic lesions. The traditional hangman's fracture was not found. To the best of our knowledge, this is the first report of complete posthanging decapitation with a severance plane between the third and fourth cervical vertebrae.

KEYWORDS: forensic science, hanging, decapitation, suicide, radiography, anthropology

Although hanging is a common suicide method all over the world, decapitation is an unusual complication (1). Posthanging decapitation is of medico-legal importance as the causal mechanisms must be sought and it must be differentiated from posthomocidal decapitation. The causal mechanisms of such a rare injury should be elucidated by careful examination and by comparison with similar cases. We present a case of self-decapitation by suicidal hanging and discuss how the beheading occurred.

Case Report

Case History

A decapitated body was found by a jogger in a park below a road bridge. The headless corpse lay against one pillar of the bridge with a large pool of blood at the base of the pillar. A considerable amount of blood had splattered on the wall facing the neck stump to a height of about 1 m, indicating bleeding from a vital artery (Fig. 1a). The head had rolled 5 m away from the trunk (Fig. 1b). A nylon rope was found tied to the base of a street lamp on the bridge. The bridge was 7.2 m above the road level. The rope was 3.6 m long, with its lower end 3.6 m above the ground and its diameter was 10 mm (Fig. 1a). The noose used was a slip knot. At the lowest part of the noose, blood stains and tissue

fragments were observed. There was no evidence of a fight or of the presence of another person at the site. The corpse was normally dressed. A handwritten letter was found inside one of the victim's trouser pockets; it indicated that he had recently divorced and had an unhappy relationship. He was identified from fingerprints as a 65-year-old man with no previous medical history.

Autopsy Findings

Autopsy revealed the body of an older Caucasian male of medium stout build, 1.7 m tall. The separated head weighed 5 kg and the torso 69 kg. Postmortem hypostasis was only slightly developed.

Plain X-rays of the skull and the cervical spine were obtained. The skull X-rays showed air in the meningeal spaces, surrounding the cerebral circumvolutions (Fig. 2a). Air was seen in both lateral and third ventricles (Fig. 2a). The skull was intact. The severance plane was between the third and the fourth cervical vertebrae (Fig. 2b). No other cervical vertebral injuries were noted.

The brain was macroscopically unremarkable except for air in the meningeal veins (Fig. 3a). The decapitation injuries of the head and the torso corresponded perfectly, without apparent loss of substance. The severance plane passed through the low ventral to the high dorsal part of the upper cervical region and the edge was sharply delineated. There was a band-like abrasion pattern with rough-toothed margins around the skin of the neck (Figs. 3b and 3c). The severance plane passed between the third and the fourth cervical vertebrae, with complete rupture of the intervertebral disc. The vertebral bodies appeared intact. The epiglottis had been torn off and remained on the head segment. The airway was severed at the trachea, between the hyoid bone and the thyroid cartilage (Figs. 3b and 3c). On gross examination, they were unremarkable and

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FIG. 1—Scene of death. (a) The wall facing the neck stump was splattered with blood up to a height of about 1 m indicating vital arterial bleeding. Splatters from bleeding of the right and the left vessels are well individualized. The lower end of the rope was 3.6 m above the ground (arrow). Blood splatters are visible between the bottom of the noose and the ground. (b) The head had rolled 5 m away from the rest of the body. Many blood splatters are visible on the ground between the head and the body.

presented no fractures or injuries. The intima of both internal carotid arteries had several horizontal tears and the adventitia showed some bruising (Fig. 3d). The entire severance plane showed marked blood extravasation in the tissue of the wound surfaces, especially in the sternocleidomastoid muscles, and bleeding was seen at the clavicular insertion of the right muscle. The other cervical vessels, spinal cord, dura and nerves were lacerated. Blood aspiration was noted with blood inside the trachea and extending into the subsegmental bronchi.

Longitudinal transfixing rupture of the thoracic aorta with circumferential hematoma was also observed. Both sixth ribs and the posterior parts of the seventh and ninth right ribs were fractured.

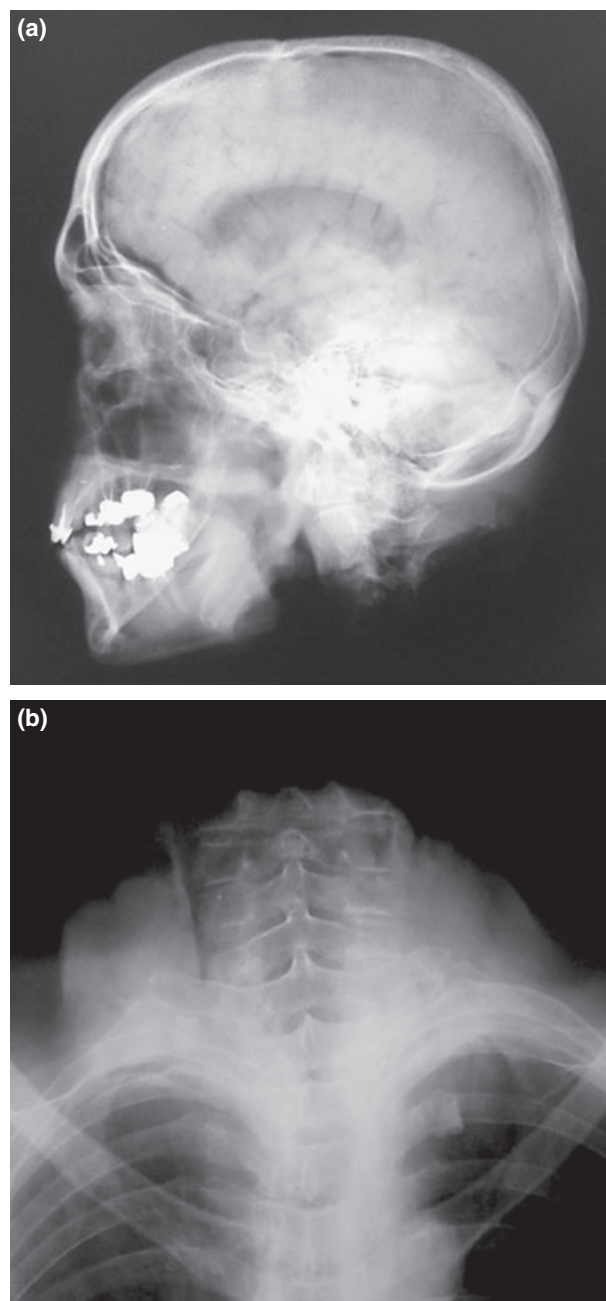


FIG. 2—X-ray study. (a) Lateral view of the skull and of the upper cervical spine above the severance plane: air is visible in the meningeal spaces and vessels, and in both lateral ventricles. The skull is intact. The lowest cervical vertebra is the third cervical vertebra. (b) Antero-posterior view of the cervical spine below the severance plane: the highest cervical vertebra is the fourth cervical vertebra. No bone injury of the cervical vertebrae is visible below the severance plane.

Marked diffuse arteriosclerosis was present. A burst fracture of the body of the twelfth dorsal vertebra was noted, with bilateral infiltration of blood in the proximal part of the psoas muscles. The other internal organs were unremarkable except for pallor due to considerable vital loss of blood. There were no other notable injuries.

Toxicological Study

Toxicological analyses, including alcohol level, were negative.

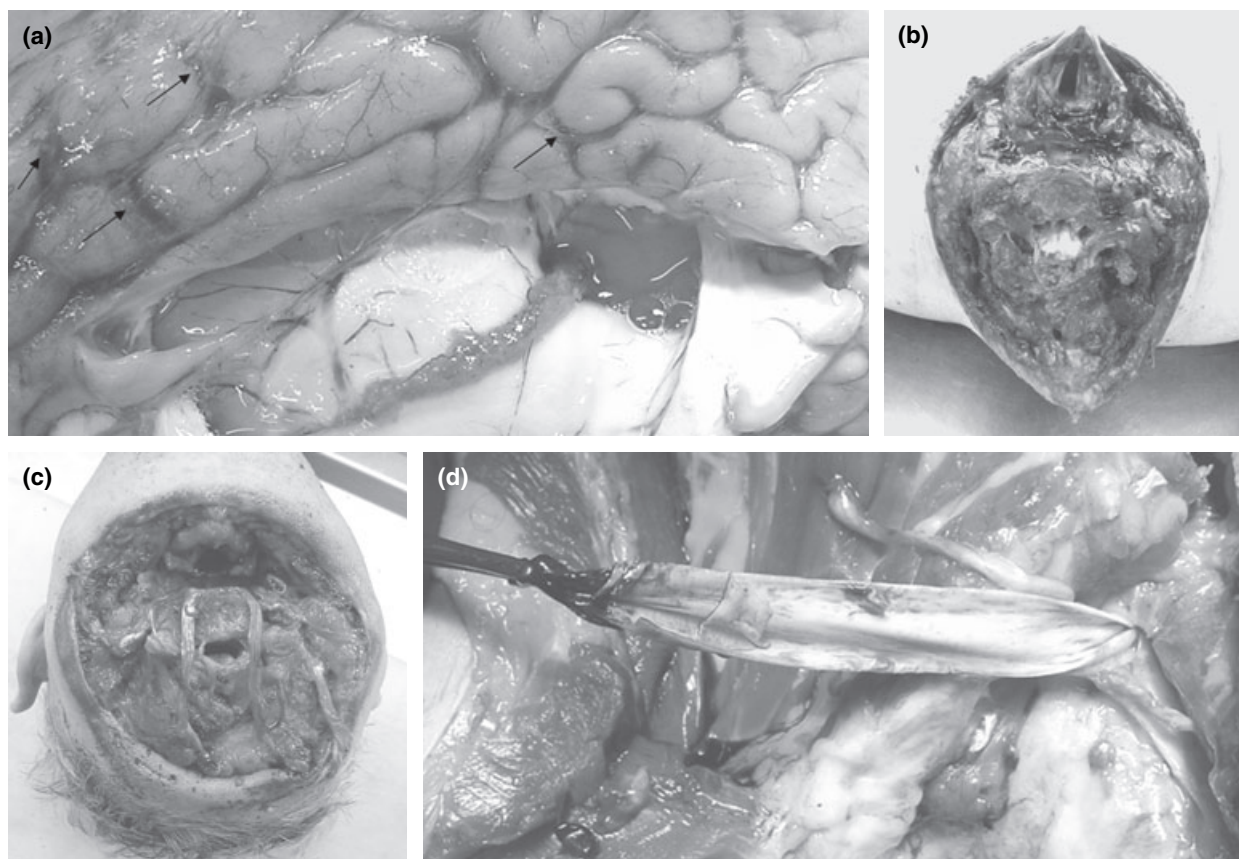


FIG. 3—Autopsy findings. (a) Air bubbles in the meningeal veins (arrows). (b) Superior view of the inferior part of the severance plane: band-like abrasion pattern with rough-toothed margins around the skin of the neck. The thyroid cartilage is clearly visible. The entire severance plane showed marked blood extravasation in the tissues of the wound surfaces. (c) Inferior view of the superior part of the severance plane: band-like abrasion pattern with rough-toothed margins around the skin of the neck. The entire severance plane showed marked blood extravasation in the tissue of the wound surfaces. (d) View of the left carotid artery: section of the distal part of the artery showing several horizontal tears of the intima and bruising of the adventitia.

Dry Bone Study

Except for fractures of the extremities of the spinous processes of the second and third cervical vertebrae, no other bone injury of the spine was seen (Fig. 4). The cervical vertebrae displayed numerous osteoarthritic lesions. The traditional hangman's fracture was not found.

Discussion

Complete decapitation is usually caused by the wheels of trains or by criminal corpse dismemberment (1,2). Beheading by hanging is rare. Suicidal hanging generally causes only soft-tissue injuries and bone lesions of the cervical spine are unusual (3). In a study of neck injuries produced by 34 judicial hangings between 1882 and 1945, with a drop ranging from 1.2 to 3 m, James and Nasmyth-Jones found only seven cervical fractures (4). A typical cervical spine injury is fracture of the isthmus of the axis (hangman's fracture) which is caused by retroflexion of the head in hanging with a long drop and a submental knot, but also by stretching of the neck combined with anteroflexion (5,6). Based on biomechanical experiments on human cervical spines, Rabl et al. (7) calculated that independently of the diameter of the rope used for the noose, axial traction forces of about 12,000 N lead to complete decapitation of human bodies. For example, in a 76 kg subject completely beheaded after a drop of 3.5 m, the loading of the neck was estimated at about 13,500 N, a value very similar to our case (74 kg

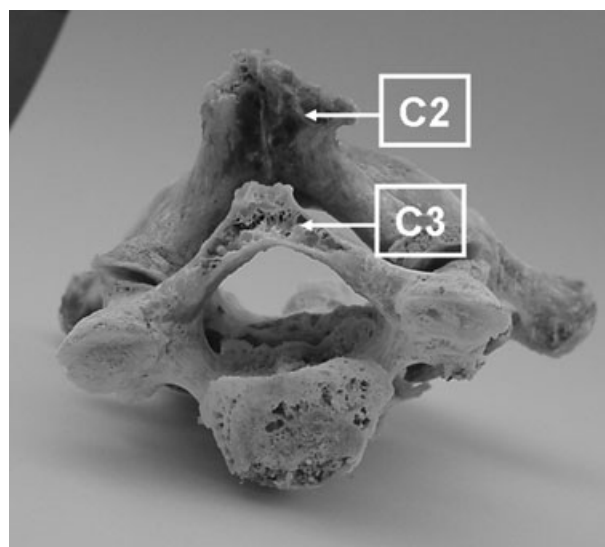


FIG. 4—Dry bone study. Inferior view of the superior edge of the severance plane: fractures of the extremities of the spinous processes of the second and third cervical vertebrae. The bodies of these vertebrae are intact and no other bone fracture of the spine is visible.

subject, 3.6 m drop). The mechanism of complete decapitation is a combination of the tearing effect of the axial traction and the shearing and crushing effect of the radial pressure of the tightening

noose. The radial force is 2 pi times greater than the traction force. The impact of this shearing and crushing effect of the radial pressure in relation to the tearing effect of the traction is dependent on the surface load on the rope and on its diameter. In the literature on decapitation by suicidal hanging, the most common cervical lesion was a tear of the intervertebral disc with intact vertebral bodies (1–3,8–12). The section of soft tissues always occurs at the uppermost part of the neck and the cervical spine, and breaks are generally between the first and second cervical vertebrae, sometimes between the second and third cervical vertebrae (1,3). However, in our observation, the cervical spine broke between the third and the fourth cervical vertebrae with fractures of the extremities of the spinous processes of the second and third cervical vertebrae. No fracture was seen in the region of the isthmus. The spinal fractures in our case were attributed to the combination of considerable axial traction and the shearing and crushing forces. To our knowledge, this severance plane has not previously been described in the literature.

A circular broad abrasion border of the cervical skin is typical of the severance edge in decapitation by hanging (12). The skin lacerations are caused by the combined effect of axial traction and radial pressure. Our findings on both cranial and caudal wound edges are consistent with previous case reports (1,3,11,12). The presence of a circumferential skin abrasion at the margin of the decapitation wound is helpful to differentiate posthanging decapitation and posthomicidal decapitation performed with a sharp cutting instrument (1,3).

Blood aspiration has been mentioned by other authors and is one of the signs of vital reaction (1,11,13). Other signs are clavicular insertion hemorrhages of the sternocleidomastoid muscles and extravasated blood in the soft parts of the severance plane (11). Another vital sign was well demonstrated on X-rays, showing air within the meningeal vessels and in the pericerebral meningeal spaces. The rib and thoracic vertebral fractures in our case were attributed to the body hitting the wall.

Our case combined all the requisite factors and conditions for complete decapitation after suicidal hanging: heavy body weight of the victim, inelastic rope, thin noose, use of a slip knot and fall from a considerable height (11).

In complete posthanging decapitation, evidence of vital reactions is of major importance in eliminating postmortem dismemberment

or mutilation. This case illustrates an unexpected consequence of suicidal hanging, with a diagnosis of vital decapitation based on autopsy findings, X-ray and dry bone studies. Furthermore, to the best of our knowledge this is the first report of complete posthanging decapitation with a severance plane between the third and fourth cervical vertebrae.

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