

Case Report

An Atypical Disease-Knowledge-Related Suicide by Means of Slashing the Hemodialytic Arteriovenous Fistula

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Abstract: A case of suicide committed by self-cutting the arteriovenous fistula in a patient on hemodialysis is presented. A 77-year-old man was found dead with a blood-stained kitchen knife in the bedroom by his daughter. The man suffered from severe chronic renal failure, for which he needed hemodialysis. Moreover, he was recently diagnosed with bladder cancer relapse. At autopsy, there was a single incised wound on the anterior surface of the left forearm, which showed a regular slash of the skin and the subcutaneous tissues. After the dissection, there was a small-sized lesion affecting the arteriovenous fistula wall. Furthermore, faint postmortem lividity and diffuse visceral pallor were observed. Consequently, the cause of death was identified as an acute hemorrhagic shock after self-cut of the arteriovenous hemodialytic fistula. This case is worthy of several medicolegal considerations: firstly, autopsy examination should always be required in cases with atypical injuries, providing important data to differentiate suicides from homicides. Secondly, disease-knowledge-related suicides are an emerging phenomenon, which deserve careful analysis. Lastly, it is important to identify patients with chronic diseases for whom psychological support is needed, preventing suicidal ideation and reducing suicide risk.

Keywords: arteriovenous fistula; sharp force injuries; disease-knowledge-related suicide; suicide; forensic pathology



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1. Introduction

An arteriovenous (AV) fistula is a surgical vascular connection of an artery to a vein. The surgeon usually places an AV fistula in the non-dominant forearm or upper arm by connecting the radial artery to the cephalic vein [1]. An AV fistula causes extra pressure and extra blood to flow into the vein, making it grow large and strong. The larger vein provides easy, reliable access to blood vessels for hemodialysis. This type of surgical access is essential to allow regular hemodialysis sessions for patients with stage 4 or 5 chronic kidney disease (i.e., glomerular filtration rate less than 30 mL/min per 1.73 m²); in fact, untreated veins cannot withstand repeated needle insertions as they would collapse [2]. Usually, an AV fistula requires 2 to 3 months to mature adequately; however, if an AV fistula fails to develop after surgery, the surgeon must repeat the procedure or perform an AV graft [3].

In this paper, the case of a 77-year-old man suffering from chronic kidney disease (CKD) who was found dead in his home with an incised wound on the anterior surface of the left forearm is presented. The autopsy revealed a small-sized lesion affecting the arteriovenous fistula wall, which caused a fatal and rapid exsanguination.

2. Case Description

A 77-year-old man was found dead in his bedroom with a blood-stained kitchen knife by his daughter. The man suffered from severe chronic renal failure, for which he needed hemodialysis three times a week. Furthermore, he was recently diagnosed with relapsing

bladder cancer; however, he did not express any death wish before and did not have a history of psychiatric diseases. The victim was last seen nine hours before the finding of the body. The apartment was tidy and locked from the inside. The cadaver was found in his pajamas under the covers in a supine position. The bed was covered in blood, estimated at about a liter and a half.

His daughter also reported that he was right-handed. According to medical history, the man took anticoagulant therapy for atrial fibrillation. Last hemodialysis was carried out the day before and, in the afternoon, before leaving the hospital, he had carried out the weekly monitoring for anticoagulant therapy.

At autopsy, there were faint postmortem lividity and diffuse multiorgan pallor. Carotids, coronary arteries, and aorta all showed atheromatous plaques; the heart showed a globous shape (weight: 520 g); the lungs were emphysematous with subpleural bullae; the kidneys were smaller than normal with signs of nephrosclerosis; the signs of a previous cystectomy with an ileal conduit urostomy were found.

A single injury was observed at the autoptic examination: there was an incised wound on the anterior surface of the left forearm, distally to the crook of the arm (length: 2 cm), which showed a regular slash of the skin and the subcutaneous tissues (Figure 1). The medial tail was sharp, while the lateral one was blunt. The superior margin of the wound was beveled and the other one overhung, indicating the oblique entrance of the knife. The medial end of the wound showed tailing off. On the inner elbow, bluish bruises and a venipuncture mark were also observed. After the dissection of the forearm, there was a small-sized lesion affecting the arteriovenous fistula wall (Figure 2A); moreover, the lesion showed sharp margins and an intense hemorrhagic infiltration (Figure 2B). The AV-fistula size measured an area of 7 cm by 3.5 cm with a diameter of 3 cm. No hesitation marks were observed near the injury and on the forearm or carpal region. Therefore, the cause of death was identified as an acute hemorrhagic shock after self-cutting of the arteriovenous hemodialytic fistula.



Figure 1. The regular and shallow slash wound on the anterior surface of the left forearm, distally to the crook of the arm; the margins are grossly infiltrated by blood. The medial tail is sharp while the lateral one is blunt. Despite the rugosity of the skin, the superior margin of the wound was beveled and the other one overhung, indicating the oblique entrance of the knife. The medial end of the wound also showed tailing off. On the inner elbow, the bluish discolorations were bruises, and a venipuncture mark was observed in the proximity.

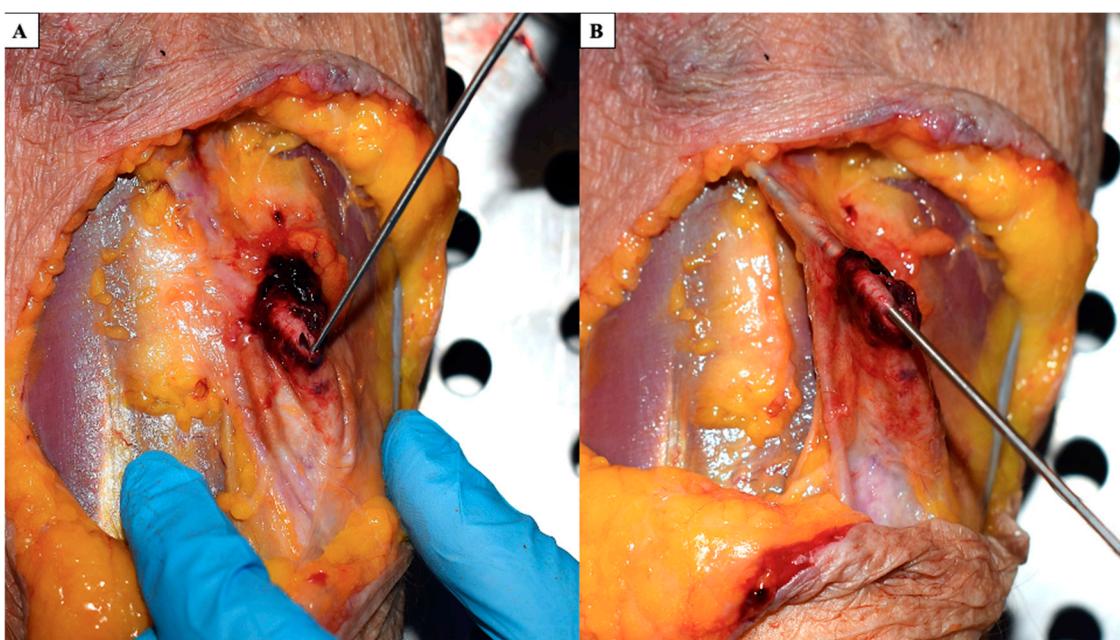


Figure 2. The dissection of the left forearm at the autopsy: (A) a very small-sized slash on the anterior surface of the arteriovenous fistula; (B) the surrounding soft tissues are grossly infiltrated by blood.

3. Discussion

Several implications can be understood from this case and are presented herein.

In the first place, autopsy examination should always be required in cases with atypical injuries, providing important data to differentiate suicides from homicides. According to the forensic literature, death caused by self-inflicted incisions is uncommon. Injuries caused by sharp objects are classified as incised or stab wounds, which are characterized by the clean and regular division of the skin and underlying soft tissues so that the margins are almost free from any damage. Specifically, an incised wound is longer than it is deep, and it may be referred to as a ‘cut’ or ‘slash’ [4]. Slashes could be caused by knives, razors, or broken glass shards; they are commonly seen in street fights, but also as self-harm injuries. Suicidal injuries typically involve the throat and wrists since in these areas vessels that can be promptly damaged by quite superficial slashes are present [5–7]. Usually, these injuries are straight-line and cross-cutting. Generally, along with the lethal wound, other superficial, sharp, forced skin cuts are described in cases of suicides, which are reported as the tentative wounds before the lethal one. In case of suicide there are no defense wounds, although uncommon self-inflicted sharp force injuries on the flexor surfaces of both wrists can mimic them [8,9]. Hence, wrists or throat self-cuts are frequently reported in the forensic literature as one of the detrimental methods in the event of complex suicide [10]. In these cases, the sharp weapon might not be found close to the victim, and there may be uncertainties for the identification of the cause of death.

On the other hand, a stab wound is an incised wound that is deeper than it is wide. Knives are the most common weapons, which may cause fatal bleedings, damaging vital deep organs such as the heart, lungs, or the liver. Suicidal stab wounds are uncommon but well-known since the past centuries (e.g., *hara-kiri*); however, such injuries are typically found in the chest with the knife *in situ* and uncovered by clothing [11].

Lacerations differ from incised wounds since tissues are irregularly damaged, showing tears rather than clean slicing. Furthermore, the margins are bruised with the evidence of fascial bands, vessels and nerves that are still intact on the bottom of the wound [4]. However, a very particular injury pattern is seen in the event of an explosion, where lacerations, and incised-type wounds could be documented all together, showing the so-called “peppering” appearance of the skin [12].

In the case presented, death was due to exsanguination from a single incised wound of the anterior surface of the left forearm, where a hemodialytic arteriovenous fistula was previously surgically prepared from the radial artery and the cephalic vein. However, exsanguination from an AV fistula is expected to be very rapid, as the blood loss comes from two medium size vessels. Moreover, the fistula is not usually set in depth—i.e., between 0.5 cm to 1.0 cm from the skin surface—so as to facilitate cannulation procedures [13]: thus, only a single superficial slash was necessary to cut the vascular wall of the fistula, causing a fatal bleeding. Wedgewood et al. [14] measured flow rates in the radial artery before and immediately subsequent to the creation of an end-to-side fistula. Flow increased from 21.6 ± 20.8 mL/min to 208 ± 175 mL/min immediately after operation whilst for well-developed fistulae flow rates may ultimately reach values between 600 and 1200 mL/min [15]. Notably, the mean values of flow volumes in the common, internal, and external carotid and vertebral arteries were 470 ± 120 , 265 ± 62 , 160 ± 66 , and 85 ± 33 mL/min on either side, respectively [16]. In the presented case, the healthcare staff of the ambulance involved in the medical assistance in the apartment of the victim estimated a blood loss of about one liter and half. Moreover, the absence of hesitative marks is rather unusual [5,7,9,11], in fact their presence usually indicates a forensic diagnosis of suicide over other possible causes of death. In this case, the AV fistula was very superficial on the skin and the sharp blade of the knife may immediately have caused the bleeding on the first attempt.

In the second place, occupation has been identified as a risk factor for suicide. Specifically, suicides may be facilitated by special knowledge or skills as well as the availability of weapons or tools due to the individual's occupational background [17,18] (including medical/anatomical knowledge). In this sense, an American study [19] revealed that men had higher suicide rates than women in all occupation categories except computers and mathematics. Among men, those in farming, fishing, and forestry had the highest age-adjusted suicide rates by firearms compared with other workers. Healthcare practitioners and technicians had the highest rate of suicide by medical poisoning. Workers involved in construction and extraction had higher rates of suicide by hanging, suffocation, or strangling. However, similarly to occupation-related suicides, victims may use their acquired and experience-based medical knowledge about chronic disorders (e.g., chronic kidney disease and AVF; chronic pain and analgesic drugs; diabetes and insulin) to guarantee a rapid and reliable suicide. Thus, as reported by Zivković et al. [20], such cases may be referred as disease-knowledge-related or medical-knowledge-related suicides [21,22].

Lastly, this case is worthy of socio-epidemiological considerations. The association of chronic kidney disease (and dialysis) with suicide is not well established in the current literature. However, recent studies [23,24] suggest that CKD shows a significantly increased risk of suicide; specifically, end-stage renal disease patients on hemodialysis had an increased risk of suicide compared with controls. Likewise, cancer patients show an increased risk of suicidality compared with the general population [25]. More specific risk factors have been identified including sociodemographic factors such as poverty, being male and elderly as well as disease-related attributes such as cancer type and stage. Therefore, it is highly advisable that healthcare providers implement standardized and systematic screening of patients with chronic conditions, including risk assessment by trained clinicians [26].

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