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CASE REPORT

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Fatal brain injury caused by the free-flying blade of a knife – case report and evaluation of the unusual weapon

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Abstract A man suffered a fatal injury from a self-inflicted accident while handling a special type of knife. A spring in the shaft of the knife accelerated the blade, which perforated the orbital cavity and the frontal lobe at the right side. Death was due to central disregulation. The initial velocity of the blade was measured to be 15 m/s. In a total of 20 experimental shots to a fresh pig cadaver, the blade always penetrated the skin and 5–10 cm of soft tissue as long as the distance did not exceed 1 m. Thin layers of bone were also perforated. The free flight of the blade did not remain stable if the distance was more than 1 m, which resulted in superficial wounds only. So this unusual construction resembling a knife can be considered an effective combat weapon for close range fighting instead of a tool.

Key words Stab wound · Knife · Brain injury · Sharp force

Introduction

Penetrating stab wounds to the head, both of the splanchnocranium (Harris et al. 1988; Grobbelaar and Knottenbelt 1991; Hudson 1992; Gardner et al. 1997; Orbay et al. 1997) and the neurocranium (Fekete and Fox 1980; Nath et al. 1984; Miller and Lipschitz 1987; Herring et al. 1998; Haworth and de Villiers 1998) occur infrequently. The eye represents a point of mechanical weakness because the back of the orbital cavity is formed by a thin layer of bone which offers less resistance to a blade than the vault. Therefore, several cases of transorbital stab wounds causing cerebral injury have been published (Hickman 1984; Bullock and van Dellen 1985; MacEwen and Fullarton 1986) and similar cases are reported from history. For example, Henry II Valois, King of France, died in 1559 of posttraumatic meningo-encephalitis after a perforating stab wound to the left eye (Bros 1993) and Harald I, King of England, received a fatal arrow wound to the eye in 1066. This case report describes a transorbital cerebral injury caused by a special type of a knife.

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Case report

During a visit to a market place, a 52-year-old man suddenly collapsed in front of a booth displaying knifes. Immediately before, the man had handled a special knife and had probably pressed the release catch which released a spring in the shaft accelerating the blade. Another visitor noticed that the blade of a knife projected from the right eye of the wounded person and immediately removed the blade from the wound. The man was declared dead at the scene.

At autopsy, it was found that the blade had perforated the right orbital cavity and the thin posterior bone layer. The wound tract subsequently perforated the right frontal lobe of the brain and the tip of the blade left an impression in the sella turcica. The clean-cut wound tract had a total length of 5 cm. Histological examination showed severe signs of brain edema and the cause of death was disruption of the central nervous system due to elevated intracranial pressure.

The special construction of the knife encountered in this case has a compressed spring inside the shaft. If the safety catch is released, the spring is set free accelerating the blade. The blade is sharpened at both sides comparable to a dagger, has a total length of 107 mm and weighs 45.7 g. The compressed spring in the shaft has a power of 55 Newton. The origin of this weapon is unknown but identical constructions have emerged in different countries. It is believed that some of these were made for special task forces of various armies. Since we have never encountered a knife capable of accelerating the blade and since this type of weapon, to the best of our knowledge, has not been described in the medical forensic literature, we used a simple set-up to evaluate the wounding potential of this weapon.

Evaluation of the weapon

The initial velocity of the blade used in the case reported was measured as $v_1 = 15\ m/s^{-1}$, 100 cm in front of the shaft by conventional light screen devices (Muzzle Velocity Meter, Mod. M-1, Shooting Chrony, Ontario Canada). For an investigation of the wounding

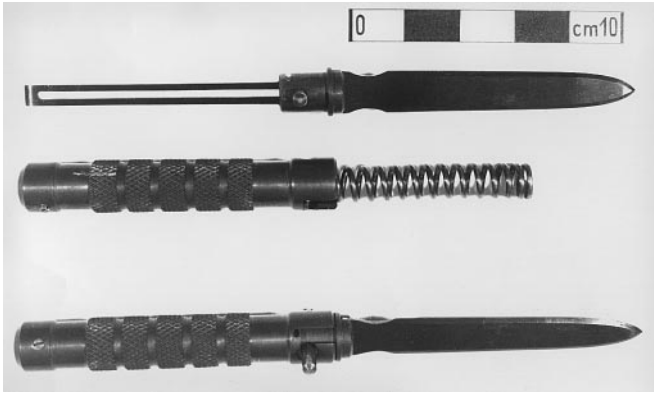

Fig. 1 The knife used for the shots to the pig cadaver. It was manufactured in the Czech Republic and is almost identical to the one used in the case reported. The complete weapon is shown above, the shaft is open showing the spring

Table 1 The target areas and the penetration depths of the blade in 20 shots to a pig cadaver

Target area	Distance	Penetration depth	Additional features
Abdomen	30 cm	7 cm	
Abdomen	30 cm	7,5 cm	
Abdomen	30 cm	8 cm	
Abdomen	30 cm	8 cm	
Abdomen	150 cm	Perforation of the skin	Unstable flight
Abdomen	180 cm	0 cm	Unstable flight
Abdomen	253 cm	0 cm	Unstable flight
Thorax	30 cm	10 cm	Intercostal space
Thorax	30 cm	10 cm	Intercostal space
Thorax	30 cm	10 cm	Intercostal space
Thorax	50 cm	10 cm	Intercostal space
Thorax	100 cm	10 cm	Costal margin and intercostal space
Thorax	100 cm	8.5 cm	Costal margin and intercostal space
Thorax	150 cm	Perforation of the skin	Unstable flight
Frontal bone	30 cm	3.5 cm	Perforation of thin bone
Frontal bone	40 cm	3.5 cm	Perforation of thin bone
Hind leg	75 cm	5 cm	
Hind leg	75 cm	5 cm	
Hind leg	75 cm	5 cm	
Hind leg	75 cm	5 cm	

potential of this type of weapon, the knife shown in Fig. 1 was used. The target was a fresh pig cadaver obtained from a slaughterhouse. A total of 20 shots were fired from a distance of 30–250 cm. The abdomen, the thorax, the frontal aspect of the head and the hind legs were used as target areas. Up to a distance of 1 m, the penetration depth of the blade in soft tissue varied between 5 and 10 cm (Table 1). If the distance was greater, the blade lost the stability during free flight and started to rotate. Consequently, the tip did not hit the target area first and only superficial scratches or a perforation of the skin occurred. The maximum flight distance of the blade was approximately 30 m.

Comment

From both the case report and the experimental evaluation, it is obvious that this type of special knife has a considerable wounding potential. The resistance of skin to a knife blade can be high (Kaatsch et al. 1993; Jones et al. 1994; Knight 1996) but this special blade always perforated the skin and several cm of soft tissue if the distance was 1 m or less. In comparison to humans, the thick and resistant skin of the pig probably compensates for the lack of clothing. Thin bone such as the back of the orbital cavity or the anterior wall of the frontal sinus in the pig was also perforated. The ballistic characteristics of this special type of knife make it clear that it is intended for use in close range fighting. This effective short range weapon can be compared to a mechanical missile throwing arm. Therefore, this type of instrument should be considered a weapon and not a tool. Since the intended use of this noiseless weapon is indisputable and the special construction can be used insidiously to take the victim by surprise, legal restrictions appear to be appropriate.

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