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The time-dependent appearance of black eyes

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Abstract The time-dependent appearance of hematomas of the eyelids was investigated in 484 cases of head injury. In individuals with apparent signs of direct violence to the orbit or the nose, black eyes could be observed even without relevant post-infliction intervals. Similarly, in victims with fractures at the anterior base of the skull hematomas of the eyelids were found even though death had occurred rapidly within less than 30 min after trauma. Black eyes that can be explained exclusively by a seepage of blood from frontal scalp wounds appeared approximately 4 h after wound infliction at the earliest, indicating a minimum post-infliction interval. Since hemorrhages of the eyelids can also be induced postmortem by direct violence to the orbit, particularly in cases with hypostasis of the face, the presence of black eyes seems not to be an unambiguous sign of vital trauma.

Key words Black eye · Head injury · Post-infliction interval

Introduction

Hematomas of the eyelids – so-called black eyes – can occur due to direct violence, following blood seepage after scalp wounds or by percolation of blood into the orbit from a fracture of the anterior fossa of the skull. With regard to these mechanisms of development, time-dependent differences in the earliest appearance of “black eyes” useful for a determination of a minimum post infliction interval can possibly be expected. Since the data reported in the forensic literature are rather limited, an extensive

autopsy material was investigated in order to provide further information on this topic.

Materials and methods

The autopsy reports of cases with head injuries ($n = 484$) resulting from falls, traffic (including rail) accidents or gunshot wounds from the Departments of Legal Medicine in Greifswald (1990–1994) and Munich (1994) were evaluated. The post-infliction interval ranged from a few seconds up to 9 months. The individuals were aged between 5 months and 92 years, and death had occurred mainly due to central dysregulation following increased brain pressure or due to such complications of long-lasting immobilization as pneumonia, pulmonary embolism, etc.

The autopsy reports were studied with regard to the presence and localization of skull fractures, of scalp hemorrhages and of evidence of direct violence to the face, in particular the orbital or nasal regions. The presence and – if possible – the distribution of hematomas of the eyelids were recorded and a possible relationship to the post-inflicting interval was investigated. Since an exact determination, in particular of rather short post-infliction intervals, was not possible in every case, a differentiation was made between “no relevant post-infliction interval” of less than 30 min and “relevant post-infliction intervals” exceeding 30 min. The details are summarized in Table 1.

Results

No evidence of black eyes

In 321 out of 484 cases (66%) with relevant head trauma, no hematomas of the eyelids could be found. Out of these 321 cases, 21 were victims of rail accidents with almost immediate death after trauma. In 7 further victims, head injury had occurred following gunshot wounds that had been self-inflicted with suicidal intent. In 19 deceased, signs of direct violence to the orbital or nasal region were found, and in 3 out of these 19 cases there were long post-infliction intervals of between 7 and 14 days. In 63 out of the 321 cases, fractures at the base of the skull, including the fossa orbitalis, were observed. In 8 out of these 63 cases, post-infliction intervals ranged from 4 h up to 9 months, while the remaining 55 victims (87%) had died

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Table 1 Frequency of black eyes in 484 cases of head trauma

	<i>n</i>	Number of cases without relevant post-infliction (interval < 30 min)	Minimum post-infliction interval	Maximum post-infliction interval ^b
<i>No hematoma</i>	321			
Direct violence	19	16 (84%)	–	–
Fracture at the base of the skull	63	55 (87%)	–	–
Scalp wounds at the forehead	37	37 (100%)	–	–
Rail accidents	21	21 (100%)	–	–
Gunshots	7	7 (100%)	–	–
Other	174	–	–	–
<i>One black eye</i>	83			
Direct violence	19	15 (79%)	–	(11 h)
Fractures at the base of the skull	39	22 (56%)	–	(7 days)
Scalp wounds at the forehead	15	(3) ^a (20%)	6 h	(23 days)
Rail accidents	2	2 (100%)	–	–
Gunshots	8	8 (100%)	–	–
<i>Two black eyes</i>	80			
Direct violence	18	11 (61%)	–	(11 days)
Fractures at the base of the skull	38	21 (55%)	–	(7 days)
Scalp wounds at the forehead	6	0 (0%)	4 h	(20 days)
Rail accidents	4	4 (100%)	–	–
Gunshots	14	12 (86%)	–	(1 day)

^aThese cases were characterized by slight blue discoloration in particular of the inner parts of the eyelids but not by development of an intense black eye

^bSince no reliable data on the time interval for the latest evidence of hematomas of the eyelids could be obtained in our series, for technical reasons, the values are set in parentheses

almost immediately after infliction of the injuries. In 37 further cases, scalp wounds at the forehead with relevant hemorrhage were detected at autopsy, but no fractures of the skull or signs of direct violence to the face. In 14 out of these 37 deceased, no relevant post-infliction interval was observed and in the other cases survival times between 2 and 1 month occurred. The remaining 174 cases (54%) without evidence of black eyes could not be assigned to any of the subgroups and were characterized by head injury with intracranial hemorrhage but no fractures at the base of the skull or scalp wounds localized in the frontal head region.

Evidence of one black eye

In 83 out of the 484 cases (17%) hematomas in the eyelids of one eye were found, and 2 out of these 83 victims had died immediately after infliction of the injuries in a rail accident. In 8 further cases, gunshot wounds of the head were a cause of almost immediate death. The gunshot injuries had led to fractures at the base of the skull in all cases. Signs of direct violence to the orbit or the nose were found in 19 further victims, and in 4 out of these 19 cases, the post-infliction intervals were 30 min up to 11 h. In 39 cases, fractures at the base of the skull, including the fossa orbitalis, were detected, and in 17 out of these 39 cases the post-infliction intervals were between 3 h and 21 days. In 15 further cases, vital scalp wounds at the forehead explained the hematomas of the eyelids, and 12 of these victims survived for intervals between 6 h and 23 days. In the remaining 3 cases slight blue discoloration of the upper eyelid was the only finding.

Evidence of two black eyes

Out of the 484 investigated autopsies 80 cases (17%) showed hematomas of eyelids of both eyes, differing in degree in some cases. In 4 victims immediate death from a rail accident must be assumed, and in 14 further cases, gunshot wounds self-inflicted with suicidal intent were the cause of death (2 victims survived for 2 h and 1 day, respectively). In all these 18 cases, fractures of the skull, including the fossa orbitalis, were detectable. Signs of direct violence to the orbit or the nose were evident in 18 further victims, and 7 survived for intervals ranging between 3 h and 11 days. Fractures at the base of the skull, and in particular of the fossa orbitalis, were found in 38 deceased, and in 17 of these cases post-infliction intervals ranging from 4 h to 7 days were observed, while in the remaining 21 cases death had occurred almost immediately. An exclusive appearance of scalp wounds at the forehead were detectable in 6 out of the 80 cases and the post-infliction interval in this subgroup ranged from 4 h to 20 days. In the case with a post-infliction interval of 4 h the eyelid hematomas were extensive and hemorrhages of the conjunctivae were also found (localization of the scalp wound: right forehead; cause of death: laceration of the cervical vertebral column without any evidence of direct violence to the face or of skull fractures). Positive results were not found in this group in cases with almost immediate death after trauma.

Fig. 1 Black eye and considerable swelling of the left forehead caused after death by dropping the corpse on the floor during removal



Localization of the hematomas of the eyelids and type of head injury

In our series, no clear relationship was found between the localization of the hematomas (upper or lower eyelid) and the mechanisms of development (direct violence to nose/orbit; seepage of blood from frontal scalp wounds; percolation of blood from fractures at the base of the skull). In all groups, some cases with hematomas involving the upper and/or lower eyelids were observed. Further examination of the possibility of a relationship between development of hematomas exclusively localized in the lower parts of the eyelids following direct violence to the nose could not be performed, since no individuals with isolated trauma of the nose were found.

Postmortem development of black eyes – a case report

A 52-year-old woman suffering from chronic depression was found dead in the bath tube of her apartment in a right position and without any evidence of external trauma to the head and in particular to the left orbit. When the body was lifted out of the bath it fell to the floor, and considerable swelling and blue discoloration, in particular of the upper eyelid of the left eye, developed (see Fig. 1).

At autopsy, a typical “emphysema aquosum” and evidence of Paltauf spots were found, leading to the diagnosis of drowning as the cause of death. The toxicological analysis revealed a toxic concentration of amitriptyline, easily explaining loss of consciousness and subsequent suicidal drowning.

Discussion

Black eyes can occur following direct violence to the orbital or the nasal regions, after fractures at the base of the skull, including the fossa orbitalis, or as a result of blood

seepage after scalp wounds [2]. With regard to the different mechanisms, time-dependent variations in the earliest appearance of hematomas of the eyelids could exist, which could possibly be useful for determination of a minimum post-infliction interval.

There is no doubt that black eyes can become evident almost immediately after direct violence to the orbit or the nose, and also in the case of gunshot wounds of the frontal or temporal head regions [3, 8], by way of rapid development of relevant hemorrhages in the soft tissue adjacent to the site of injury, as confirmed by the high proportion (approximately 78%) of our cases with positive results showing evidence of direct violence to the face or gunshot wounds of the head but not relevant post-infliction intervals. The different types of violent injury can be expected to lead to different localizations of the hematomas. For example, it is conceivable that hemorrhages following direct violence to the nasal region lead to hematomas of the inferior eyelids due to gravitational forces. In cases of direct trauma to the orbit, however, the superior parts of the eyelids are most frequently involved, but involvement of the lower lid is also possible. In our series, hematomas of the superior and/or of the inferior eyelids were observed both in individuals showing signs of direct violence to the orbit and to the frontal region of the forehead and in victims with evidence of fractures at the base of the skull. Therefore, no information on the type of trauma can be obtained by evaluation of the localization of the hematomas. On the other hand, no cases with isolated trauma of the nose were found in our series, and the assumption that direct violence to the nose produces hematomas of the lower eyelids in particular could not be examined further.

With respect to the second possible mechanism of the development of black eyes following fractures at the base

of the skull by percolation of blood into the orbit, time intervals of 2–3 days before the appearance of relevant hematomas are reported by Mueller [6]. Prokop and Göhler [7] however, found hematomas of the eyelids after post-infliction intervals of approximately 30–60 min at the earliest, whereas extensive hemorrhages of any eyelids were detected at the earliest “hours or even days” after infliction of the fractures. In our series, rapid development of hematomas of a single eyelid (of one or both eyes) was found even in some cases of rail accidents without evidence of direct violence to the orbit or the nose, indicating that such findings can also occur when death is almost immediate once the injury is sustained. Furthermore, hematomas of the eyelids could be detected in cases of rapid death due to severe head injury but without a complete laceration of the base of the skull, as observed in most rail accident victims. In accordance with the results of Prokop and Göhler [7], it must therefore be emphasized that the development of hematomas of single eyelids seems to be quite possible in cases without relevant time intervals between wound infliction and death. On the other hand, our findings indicate that longer post-infliction intervals are not necessary for the development of black eyes following fractures at the base of the skull. Therefore, the appearance of hematomas of the eyelids can be regarded as an early sign of fractures at the base of the skull. A relationship between the extent of the hematomas and the post infliction interval seems to be unambiguous however, and it can be assumed that extensive hematomas of all eyelids probably cannot be expected in cases with almost immediate death.

With regard to a possible development of black eyes due to the seepage of blood from frontal scalp wounds, Knight [2] suggests post-infliction intervals of “at least some minutes between time of injury and death and at least a partially upright posture of the head” as necessary conditions. In cases with a localization of the scalp lesion high up on the frontal region this “time-interval will probably be measured in hours if not longer”. In keeping with this assumption, the appearance of typical black eyes with extensive hematomas of all eyelids could be observed in our series after a post-infliction interval of approximately 4 h at least. In this case, the scalp wound was localized in the central region of the forehead, suggesting that a time interval of at least a few hours is necessary. A very slight blue discoloration of single eyelids, however, was also found in 3 cases without relevant post-infliction intervals, but these findings could not be regarded as a typical black eye because the discoloration was so slight.

A reliable conclusion on the longest time interval for evidence of black eyes after trauma cannot be drawn from our results owing to the rather limited number of cases with long post-infliction intervals, and in particular with regard to the relationship between evidence of hematomas and the initial extent of the hemorrhages. It can be em-

phasized, however, that black eyes can still be observed a few weeks after trauma, as indicated by our case with an interval of 23 days between time of injury and death.

Finally, postmortem induction of black eyes must be discussed. There is no doubt that manipulation at the eye or the orbit such as is needed during removal of the eyes for corneal transplantation is sufficient to produce considerable hematomas of the eyelids [4]. Furthermore, they can also develop following postmortem violence to the orbit, as observed in our case report. Therefore, hematomas of the eyelids and simultaneous evidence of direct violence to the orbital or the nasal region, in particular in cases of hypostasis of the face, cannot be unambiguously interpreted as a vital sign. In addition, development of hematomas in the frontal scalp after postmortem infliction of wounds can be observed in cases of hypostasis, and the possibility cannot be excluded that seepage of blood into the orbital region occurred in the deceased with an upright posture of the head. In addition, both Geserick et al. [1] and Lignitz et al. [5] described postmortem development of fractures of the fossa orbitalis as a sign of contrecoup following falls onto the occipital region of the head. In their experimental studies on corpses, they even observed bleeding from the external ear. On the other hand, the authors did not find any evidence for an appearance of black eyes, and it is not easily conceivable that postmortem-induced secondary fractures of the fossa orbitalis without direct violence to the frontal head lead to soft tissue hemorrhages of a sufficient degree to produce typical black eyes. With regard to the possible mechanisms of postmortem development, however, it must be emphasized that the evidence of (slight) hematomas, in particular of single eyelids, cannot be unambiguously interpreted as a result of vital injury, whereas the appearance of extensive hematomas of both lids of both eyes in the absence of any signs of direct violence to the orbit does indicate a vital trauma.

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