

An interesting case of arterial trauma after craniocerebral injury

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Received December 22, 1989 / Received in revised form August 6, 1990

Summary. A 63-year-old drunken man fell and hit his head on the ground. Apart from symptoms of alcoholisation no signs of severe injuries were found. The man died 2½ days after the accident. The autopsy revealed a huge fracture system in the right parietal region. A branch of the medial cerebral artery was stretched between the cortex and one of the fracture lines, passing through a tear in the dura. Characteristics of this case were that no larger hemorrhage was found and the artery which was torn from the cortex showed no lesions. The case also indicates the immense relative movements between skull and brain which occur during such trauma.

Key words: Forensic neuropathology – Craniocerebral injury – Cortical artery lesion – Biomechanism

Zusammenfassung. Ein 63jähriger Alkoholiker stürzt in betrunkenem Zustand im Treppenhaus. Auf der Rettungstelle ist der Mann schläfrig aber bei Bewußtsein; es werden neben der Alkoholisierung keine gravierenden Verletzungen festgestellt, Röntgenaufnahmen des Schädels verwickeln. Übernachtung in Polizeigewahrsam (GeSa), am nächsten Morgen zu Fuß nach Hause, dort über 2 Tage Eintrübung, Nausea, Erbrechen. 2½ Tage nach dem Sturz von Ehefrau leblos im Bett aufgefunden. Obduktion: Oberfl. Schürfung Kopfhaut re. parietal, darunter Blutungen in der Galea und re. M. temp.; ausgedehntes Bruchsystem re. Parietalregion. Ein Ast der re. A. cerebri media war durch einen Riß der Dura ziehend zwischen Cortex und einer der Frakturlinien aufgespannt. Intracranielle Blutungen konnten ebenso wie Verletzungen der Arterie selbst nicht beobachtet werden. Der Fall ist erneut ein Indiz für die großen Relativbewegungen zwischen Gehirn und Schädel bei derartigen Traumen.

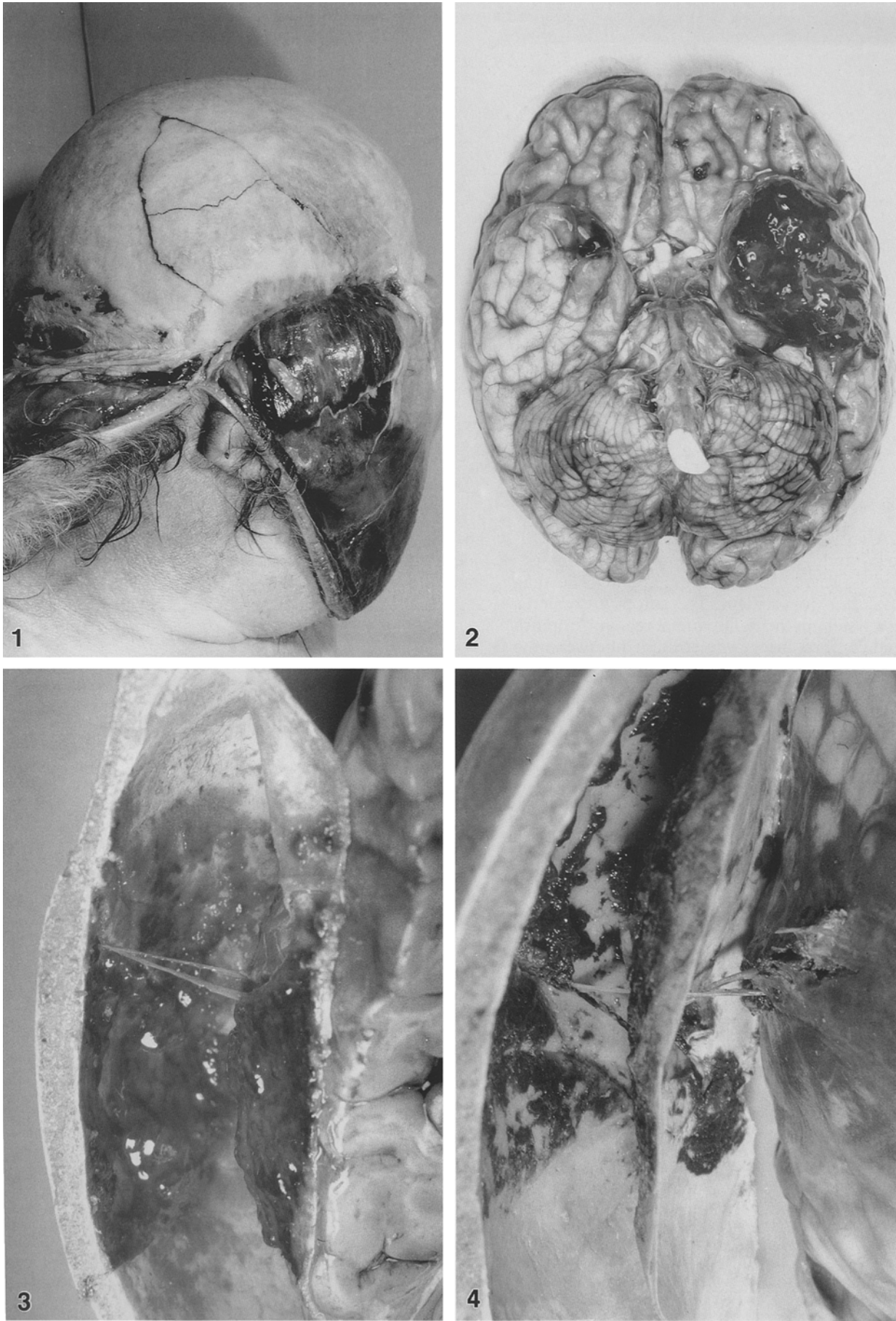
Schlüsselwörter: Forensische Neuropathologie – Schädel-Hirn-Trauma – Corticale Arterienverletzung – Biomechanismus

Introduction – case history

A 63-year-old chronic alcoholic fell in the well of a staircase and was brought to the emergency department of a hospital, where he was conscious but drowsy. Apart from the alcoholisation, only a superficial skin scratch over the right parietal region was diagnosed. X-rays of the skull were not taken because of the uncooperative manners of the man; fractures could not be seen. Because of the lack of severe injuries and severe alcoholic state he was kept overnight at the police station. The next morning he left and walked home. There he became more and more sleepy, became nauseous and often vomited. He was found dead by his wife 2½ days after the fall.

Autopsy findings

The skin of the right parietal region showed only a slight superficial abrasion. The right galea and the right temporal muscle showed bleeding. A fracture system started at the right parietal bone, going through the right temporal bone and the zygomatic os, ending in the medial fossa cranialis (Fig. 1). On opening the skull, the cerebral base showed severe contusions of the left temporal pole (contre-coup) (Fig. 2). The upper half of the brain was left in the cranium, where a thin epidural blood layer was seen. After the dura was detached from the internal tabula, a blood vessel was found to be stretched from the



surface of the dura to the skull where it was pinched in a fracture line (Fig. 3). At first sight it appeared to be a branch of the medial meningeal artery but after fixing the brain and the upper half of the skull in formalin for 2 weeks it was discovered that the blood vessel was a branch of the medial cerebral artery, originating at the surface of the parietal region of the cortex, traversing the lacerated dura and ending in one of the fracture lines (Fig. 4). Congruent to the fracture line in which the artery was pinched, the superficial parts of the parietal cortex had been lacerated for 4 cm (Fig. 5) and the dura had a depth of approximately equal size. Around the cortical laceration was a contusion 4×5 cm (coup), but no larger subdural hemorrhage.

Further findings were a moderate arteriosclerosis and a tumor in the left adrenal gland. In accordance with the history of chronic alcohol abuse a massive fatty degeneration of the liver and an induration of the pancreas were found. The brain weighed 1780 g.

Death was finally caused by massive edema of the brain and slight petechial bleeding in the pons.

Biomechanism

Due to the fall, the head was in motion when it struck the ground (Fig. 6a). The skull was fractured and the fracture line gaped because of deformation of the bone (Fig. 6b) (Courville 1961, 1962; Krauland 1982). The inertia forced the cortex tissues of the brain into this fracture gap (Krauland 1982). Thereafter the movement was reversed (Fig. 6c) and the fracture gap was reclosed, because of reformation of the skull pinching superficial parts of the cortex. Being elastic the brain reverted to its original position in the course of which the pinched artery was torn from the cortex.

Discussion

The first case of isolated trauma of a cortical artery was described by Werkgartner (1922). Many publications followed in which ruptures of cortical arteries were found to be the cause of subdural hemorrhage (Hey 1925; Vance 1950; Schneider 1970; Dirnhofer, Sigrist 1977; etc.).

Krauland (1982) found that in most cases more or less isolated damage to cortical arteries was found localised

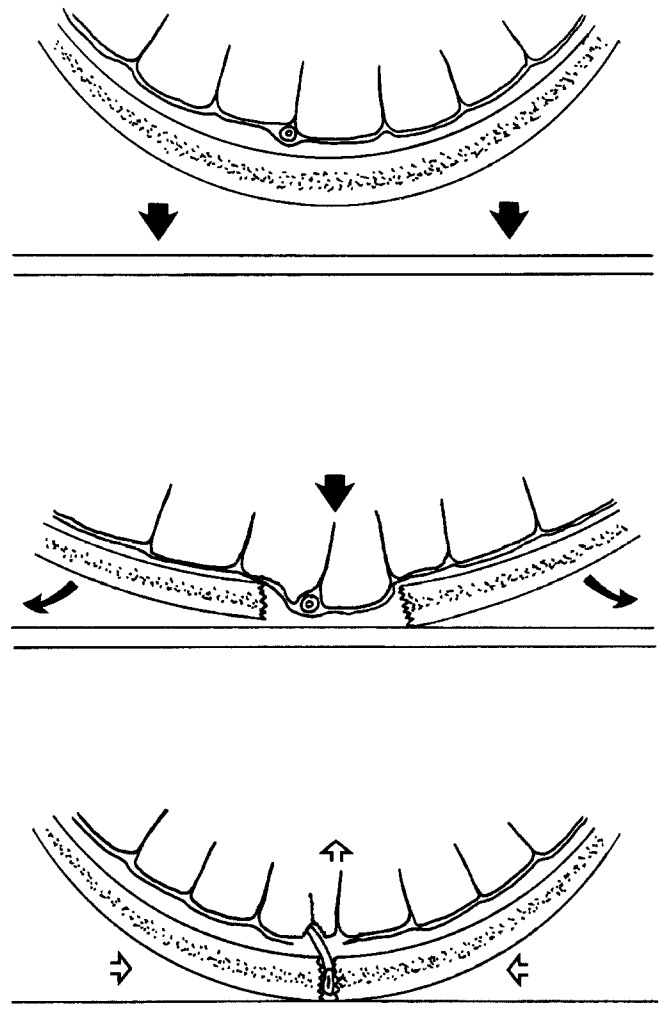


Fig. 6a–c. Biomechanical scheme: **a** The moving head hits an immobile object. **b** Deformation forces spread the fracture gap, the inertia forcing parts of the cortex into this gap. **c** Reformation powers close the fracture gap pinching and stretching the cortical artery

in the cortical area where the bigger branches of the medial cerebral artery ascend from the island and the occipital part of the Sylvian fissura.

One peculiarity of this case is that after surviving the fall for 2½ days only very limited intracranial bleeding could be seen despite alcoholic liver damage and such an extensive arterial traumatization. Histological examination of the injured cortex and the artery showed no signs of thrombosis or greater contractions of the vessel (Fig. 7 and 8). The findings indicated that the artery was completely sealed by having been pinched in the fracture gap without any other hemostatic mechanisms taking place.

Another characteristic is that the artery, which was torn from its cortical “bed” for some centimeters, showed no greater damage (Fig. 9). Apart from isolated tears in the arterial wall only slight detachment of the intima could be seen and no thrombosis or spasms could be found in the isolated artery.

Finally this case in which an artery was torn from the cerebral cortex for some centimeters, is another example

Fig. 1. Fracture system in the right parieto-temporal region, bleeding in the right galea and the right temporal muscle

Fig. 2. Contre-coup contusions of the left temporal lobe and slight contusions in the inner part of the right temporal lobe

Fig. 3. After removing the dura from the internal tabula. 2 blood vessels connected via small side-branches are stretched from the surface of the dura to the skull where they are pinched in a fracture gap. Between dura and skull is a thin epidural blood layer

Fig. 4. After 2 weeks fixation in formalin, it can be seen that the blood vessel and the side branch have their origins at the surface of the parietal region of the cortex, traverse the lacerated dura and end in one of the fracture gaps

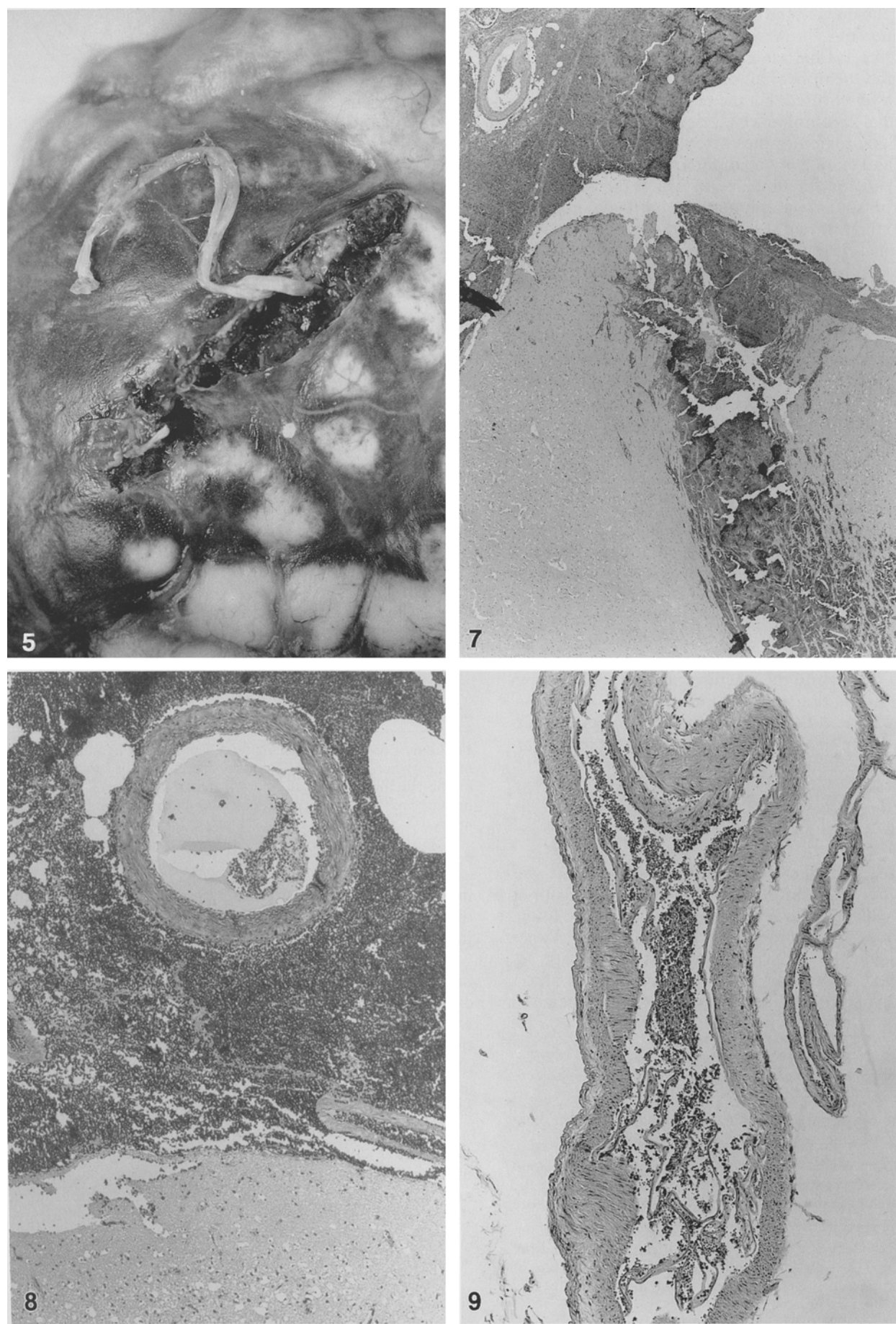


Fig. 5. The lacerated parietal cortex with the severed artery

Fig. 7. The lacerated cortex and artery in the left upper corner (H & E $\times 15$)

Fig. 8. The artery shortly before the torn off parts, showing no thrombosis or spasms (Azan $\times 80$)

Fig. 9. Part of the isolated artery, showing only slight detachment of the intima but no greater damages itself (H & E $\times 64$)

of the immense relative movements between brain and skull during such trauma.

References

- Courville CB (1961) Forensic neuropathology. I. Introduction – technical matters. *J Forensic Sci* 6:445–468
- Courville CB (1962) Forensic neuropathology. II. Mechanisms of craniocerebral injury and their medicolegal significance. *J Forensic Sci* 7:1–28
- Dirnhofer R, Sigrist T (1977) Chronisches subdurales Hämatom nach Schleudertrauma. In: Schneider V (ed) *Festschrift W. Krauland*. Zentrale Universitätsdruckerei, Berlin, pp 103–120
- Hey R (1925) Subdurales Hämatom als Sportverletzung. *Dtsch Z Gesamte Gerichtl Med* 5:12–16
- Krauland W (1982) Verletzungen der kortikalen Schlagadern, subdurale Blutung. In: Krauland W (ed) *Verletzungen der intrakraniellen Schlagadern*. Springer, Berlin Heidelberg New York, pp 177–234
- Schneider V (1970) Traumatische Aneurysmen der Schlagadern an der Mantelfläche des Großhirns und ihre Beziehungen zu subduralen Blutungen. *Monatsschr Unfallheilk* 73:63–69
- Vance BM (1950) Ruptures of surface blood vessels on cerebral hemispheres as a cause of subdural hemorrhage. *Arch Surg* 61:992–1006
- Werkgartner A (1922) Subdurale Blutungen aus verborgener Quelle. *Beitr Gerichtl Med* 5:191–211