CORRESPONDENCE

Coma After Acute Head Injury

by Prof. Dr. med. Raimund Firsching in issue 18/2017

Ocular Signs Should Be Given Attention

In his explanations of the examination and treatment of patients in a coma after acute head injury, Firsching primarily pointed out the prognostic importance of unilateral and bilateral pupillary unresponsiveness (1). In patients in a coma, further ocular signs should be heeded, in addition to the pupillary reflex, such as pendular eye movements, nystagmus, ocular bobbing, skew deviation, or conjugate eye deviation. Furthermore, the tonus of the eyelid muscles should be checked, as should the measurement of the opening in incomplete eyelid closure, corneal reflexes should be tested, Bell's phenomenon should be checked for, the positioning of the eyes, and enophthalmos or exophthalmos. Noises above the temple and eye region can be auscultated. Unilateral mydriasis indicates ipsilateral brain injury as a result of epidural or subdural hematoma. Mydrasis in this setting can increase further; in intracranial hematoma, the pupil may adopt an oval shape ("football pupil") (2). DOI: 10.3238/arztebl.2017.0643a

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Falls Are More Common Than Traffic Crashes

I was interested to read Firsching's excellent article on the treatment and prognosis of acute head injury (1). Unfortunately, however, he mentions only by implication age specific aspects and therefore differences in the topics addressed in the article. The cover image of the issue does not adequately reflect the current epidemiology of acute head injury. It suggests that acute head injury often affects young motorcyclists who are willing to take risks. Newer studies have found, however, that patients' age has risen continuously over recent years, and that, meanwhile, falls have taken over from traffic accidents as the most common causes of acute head injury (2, 3). Although claims have been made to the contrary, over the past two decades no reduction in mortality due to acute head injury has been observed, and neither have outcomes improved to any significant degree (2).

Demographic changes, as well as the associated epidemiological changes—including the associated particularities relating to acute head injury—have introduced even more complexity into the subject and therefore underline the relevance of this entity for future research. DOI: 10.3238/arztebl.2017.0643b

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Tissue Pressure and Perfusion

The rise in intracranial pressure caused by posttraumatic hemorrhage is not caused simply by the increased blood volume but to a large extent by secondary tissue edema. This develops subsequent to pressure-related hypoxia, initially immediately adjacent to the bleed. In this setting, the raised tissue pressure is caused by distension of the elastic cerebral structures and therefore reduces perfusion pressure in the blood vessels at the edge of the hemorrhage.

The problem is that craniectomy—which the article focused on—can lower intracranial pressure in large areas (wherever this is measured) (2), but does not affect the distension of cerebral tissue at the edge of the hemorrhage. Perifocal tissue necroses may be a result, such as can be seen in *Figure 2f* in the article, in spite of timely craniectomy (CT scan obtained 2 hours after road crash) (3).

However, craniectomy can (with extensive duraplasty) ensure that herniation of cerebral tissue into the infratentorial region is mostly prevented and therefore the risk of pressure-related brainstem necrosis is reduced.

Figure 1a in the article (or the corresponding clinical course: epidural hematoma, operated 3 hours after the crash) shows that even here, the primarily presumed herniation of brainstem and cerebellar tonsils has not led to lasting injury even 3 hours after the event, such as was documented in the other case (*Figure 1c*), where the hematoma had obviously been drained much later (3). It always should be borne in mind, however, that epidural hemorrhages can develop slowly and gradually.

Pathophysiologically, the most sensible therapeutic recommendation in a scenario of contusion related hemorrhage is definitely (organ-sparing) surgical drainage or reduction of the hematoma. In this setting, the reduction in the volume of the hematoma as well as in edema formation will lower locally raised tissue pressure. DOI: 10.3238/arztebl.2017.0643c

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In Reply:

My thanks go to the correspondents and their professional and helpful comments. Prof. Schmidt adds from an ophthalmologist's perspective further possible disorders of pupillary and ocular function. MRI scanning has recently confirmed that pupillary unresponsiveness is indicative of brain injury (1). However, even in the past, larger clinical series reported in 7% of cases pupils unilaterally unresponsive to light with intracranial bleeds on the contralateral side (2). As example 2 from the article shows, pupillary dysfunction can be caused not only by subdural or epidural hematoma, but also by brain swelling and contused brain tissue (2, 3).

Prof. Maegele expresses concern that the cover page, with a motorcycle helmet lying on the tarmac, might suggest that acute head injury affects only young motorcyclists who are prepared to take risks. I am convinced that the editors of *Deutsches Ärzteblatt* did not intend to communicate an epidemiological message by putting the helmet on the cover. I can certainly agree with the point made, that the average age of patients with acute head injury is rising—this is obviously a consequence of the increase in the average age of Germany's population. I also agree that treatment results over recent decades have not improved—the available literature certainly supports that. Computed tomography scanning—the crucial imaging technique in this setting—has been available for 40 years. However, whereas the imaging procedure in 1978 took about 1 hour, the same image can now be obtained within 10 seconds. Treatment strategies have not changed fundamentally. As decompressive craniectomy has been found helpful in stroke patients, it is now also used in acute head injury. Whether this will help a statistical improvement in outcomes remains to be seen.

Neuropathologist Dr. Barz focuses on the pathophysiological process of space occupying intracranial lesions after traumatic head injury. His point, that epidural hematomata may develop slowly and gradually, is of utmost practical importance and gave rise to the recommendation in the guidelines of the Association of Scientific Medical Societies in Germany (*Arbeitsgemeinschaft wissenschaftlicher medizinischer Fachgesellschaften*, AWMF), that no more than 1 hour after the accident should pass before imaging is obtained, ideally a CT scan, because an epidural hematoma usually reaches its space occupying size after 1 hour at the earliest—sometimes even later. The hematoma should be drained/reduced not only in an "organ sparing" way, as the neuropathologist requests—this is self-evident for neurosurgeons—but primarily in a timely fashion, before a functional brain lesion turns into irreversible morphological damage (see *Figure 1* in the article). DOI: 10.3238/arztebl.2017.0644

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Conflict of interest statement
The authors declare that no conflict of interest exists.