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Correlations of CT-Findings and Neuropathological Investigations in Cranio-Cerebral Trauma*

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Summary. For direct comparison of computerized tomograms (CT) and autopsy findings after cranio-cerebral trauma 86 brain specimes were sectioned along the horizontal planes of CT-scanning. A high reliability of the new x-ray method was found in about 72 % of the investigated cases. The causes of insufficient correspondence in other cases were discussed.

Key words: Computer-tomography, cranio-cerebral trauma – Cranio-cerebral trauma, computer-tomography.

Zusammenfassung. Um einen direkten Vergleich von Computer-Tomogrammen und Autopsiebefunden nach Schädelhirntraumen zu erreichen, wurden 86 formolfixierte Gehirne entsprechend der horizontalen Schnittebenen des Computer-Tomogramms geschnitten und untersucht. In 72 % der Fälle fand sich eine hohe Übereinstimmung zwischen der neuen Röntgen-Untersuchungsmethode und den pathologisch anatomischen Vergleichspräparaten. Die Ursachen unzureichender Korrelierbarkeit der übrigen Fälle werden diskutiert.

Schlüsselwörter: Computer-Tomographie, Schädelhirntrauma – Schädelhirntrauma, Computer-Tomographie.

In cranio-cerebral trauma computerized tomography which was introduced some years ago is a remarkable progress in diagnostics [1–4]. While the conventional neuroradiological methods permitted only the indirect visualization of most head injury sequelae (displacement of the ventricular system or of the normal intracranial vasculature), this new method enables the direct demonstration of hemorrhages, contusions and posttraumatic edemas [2–7].

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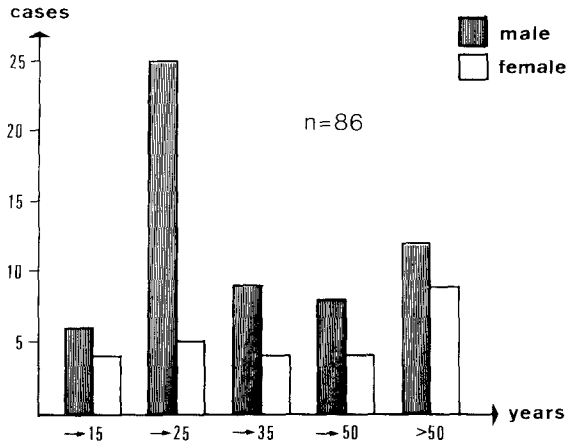

Fig. 1. Age groups of the investigated cases

To demonstrate the reliability of the new method in head injuries we compared the CT-findings with post mortem studies in fatally injured patients.

Material and Method

During the last 22 months we investigated 86 cases of brain damage caused by accidents. Among a majority of traffic accidents we collected 7 cases of suicidal self shooting and 8 cases of other various cerebral trauma. The age groups of our analized cases are shown in Fig. 1. Among these the high risk of young male drivers is evident.

The fixation of the brains was done with increasing concentrations of formalin (5 to 10 %) over a period of 14–20 days.

For direct comparison of CT and autopsy findings the brains were sectioned along the horizontal planes of CT-scanning (Fig. 2). An adjustable frame was useful to get a correct and symmetrical basal slice of the brain specimens. In all cases 6 brain sections were done.

Results

In 72 % of our cases the correlations between CT-findings and their anatomical equivalents was remarkable close. The congruity shall be demonstrated by a few examples:

SN 75/77–75 years old male, hit by a falling tree. Large depressed fracture in the left temporo-parietal region. CT revealed a massive paramedian bleeding with plugging of the ventricular system (hematocephalus internus). These findings were confirmed by the anatomical investigations. Interval between trauma and death 6 hours (Fig. 3).

SN 213/77–male of the age 75. Suicide by shooting into the right temporal region (wound of exit in the left zygomatic bone). CT demonstrated an increased right temporopolar density and a perifocal edema (left hemiparese) which correlated with the hemorrhagic necrotic defects of the basis of the right temporo-frontal region, a bleeding into the right basal ganglia and the cerebral edema with shifting of the midline structures to the left, herniation of the cerebellar tonsils. The brain damage was survived for 10 days (Fig. 4).

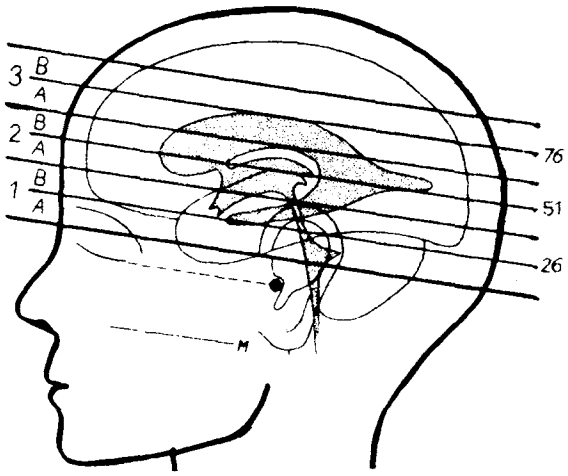

Fig. 2. Horizontal planes of CT-scanning of the brain

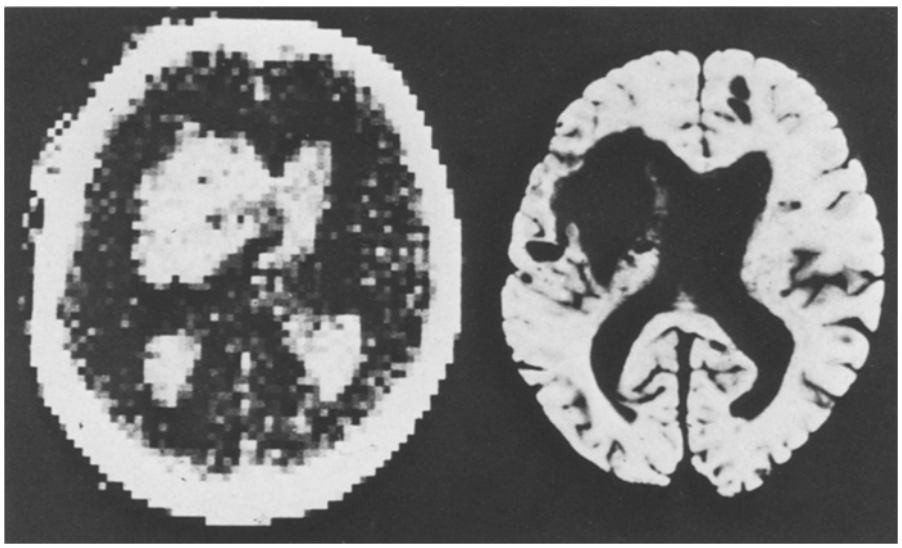

Fig. 3. Cranio-cerebral trauma by a falling tree, large paramedian bleeding, hematocephalus internus (SN 75/77)

SN 170/78–74 years old male cyclist, collision with a motor-bike. CT showed large contusional hemorrhages of both temporo-parietal regions. Post mortem findings were large bleedings and nectrotic defects close to the stem ganglia, rupture into the ventricular system, shifting of the midline to the left. Interval 14 days (Fig. 5).

SN 180/78–Fifty four years old male. Fall from a cherry tree. Occipital fracture of the skull. CT showed large contusional bleedings of the left frontal lobe going deep into the white matter of the brain. Post mortem revealed the large hemorrhage in the left fronto-basal region up to the Sylvii fissure, small temporopolar herd of contusion. Moderate shifting of the midline towards right. Interval 20 days (Fig. 6).

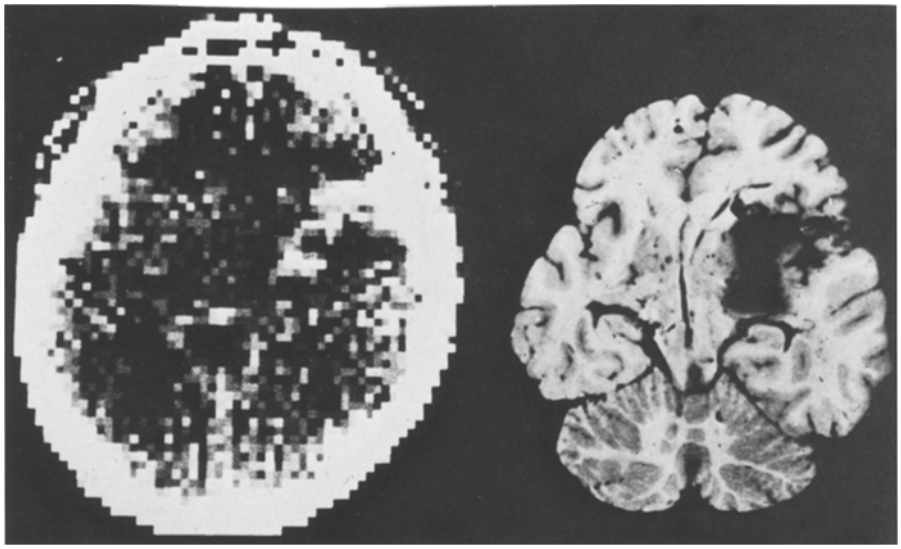

Fig. 4. Suicide, bullet injury of the right temporal region (SN 213/77)

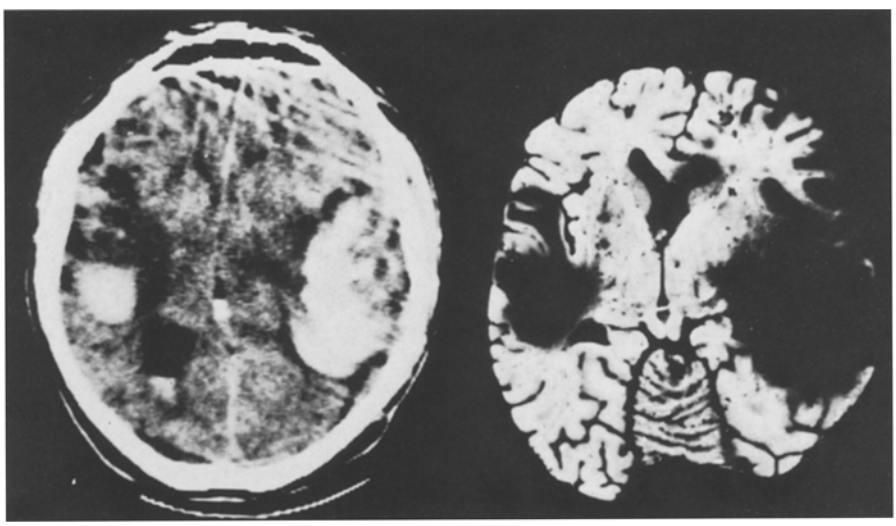

Fig. 5. Head injury after a collision of a cyclist. Bilateral contusional hemorrhages (SN 170/78)

In about 12 % of our cases the correlation of CT and morphological findings were moderate. The rest (16 %) showed no sufficient correspondence respectively there was no possibility for direct comparison in respect to different interferences, which will have to be discussed:

In some cases not all planes were investigated by CT. So positive morphological findings especially along the base of the skull and in the upper parietal region had no corresponding documentation.

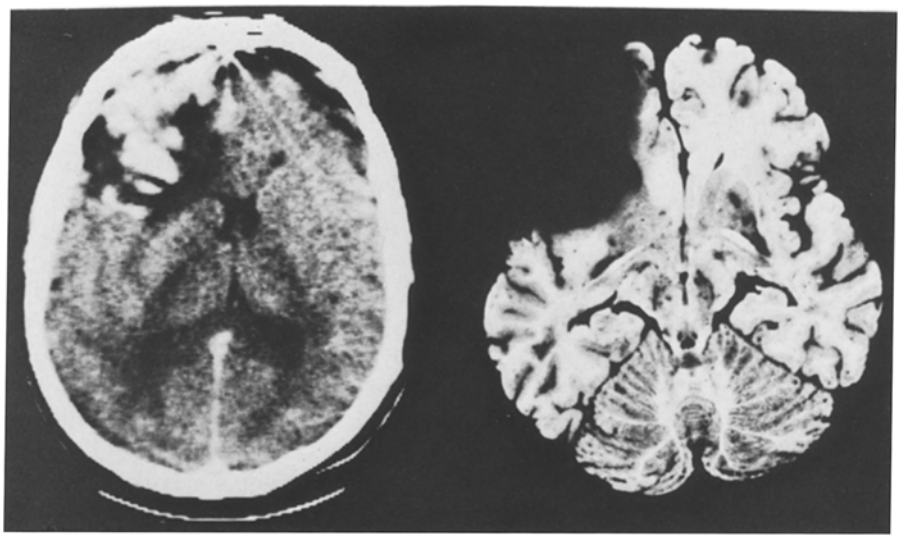

Fig. 6. Fall from a great hight, large contusional bleeding in the left frontal region (SN 180/78)

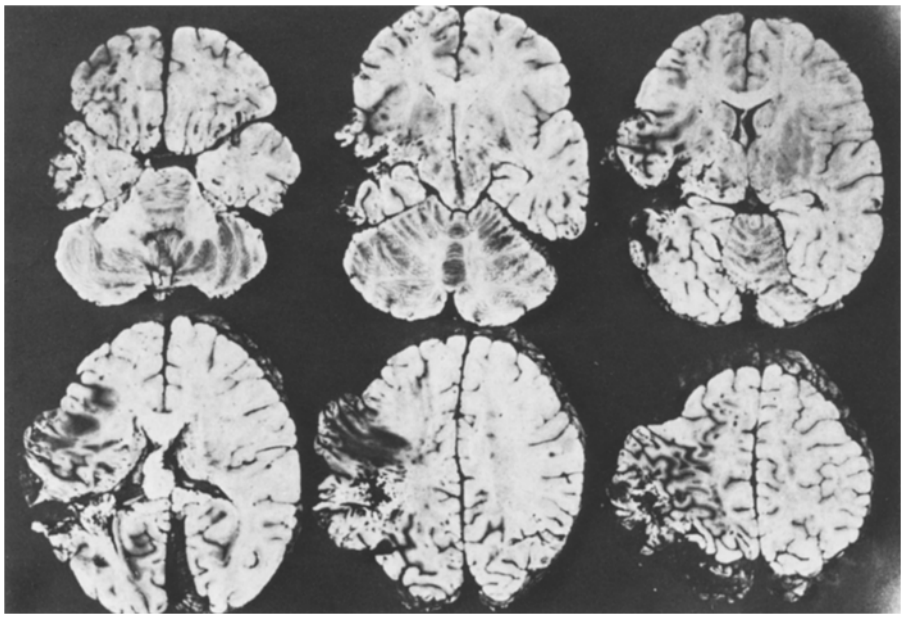

Fig. 7. Operation of an intracerebral hematoma, herniation of the brain by increased intracranial pressure (SN 108/77)

In the CT the average absorption of x-rays is mapped according to the slice-thickness of each investigated plane. By this effect of "volume averaging" lesions close to the bone structures of the cranial fossas as well as thin layers of bleedings cannot be identified in the horizontal cuts.

Time interval between CT and death may often interfere with direct comparison. Because of the alteration of bleedings and the developing of a perifocal edema, contusions may look different as to their shape and extent. So the original condition of brain damage sometimes cannot be reproduced after a certain period of time. In cases of surgical intervention direct comparison of preoperative CT and post mortem findings is also impossible.

SN 108/77–Fig. 7 shows brain sections of a 20 years old male, who was operated on a large intracerebral hematoma on the left side leaving an osteoplastic defect to prevent intracranial hypertension. Due to increasing intracranial pressure a massive prolaps of brain tissue developed causing secondary bleeding by shifting of brain. Interval between operation and death 10 days.

Last not least the results were handicapped by the relatively rough matrix (80 x 80) of our Computer-Tomograph of the elder generation, which was used until the beginning of this year. So small structures less than 1 cm in diameter were missed. Many of these problems are no longer threatening since a new modern machine (Siretom 2000, Siemens AG) came into clinical use in our neurosurgical department. Even small structures of less than 5 mm in diameter can be identified as well as thin layers of subdural and epidural bleedings. By this sophisticated method we now get better correlations to anatomical findings which gives a pretty good outlook for the diagnostics in times to come. Referring to the delivery of medical expert opinions and medical certificates the results also demonstrate the high reliability of CT-findings in head trauma.

References

1. Ambrose, J.: Computerized Transverse Axial Scanning (Tomography): Part 2. Clinical Application. Brit. J. Radiol. **46**, 1023 (1973)
2. Ambrose, J., Gooding, M. R.: E. M. J. Scan in the Management of Head Injuries. Lancet 1976, 1, 847
3. French, B. N., Dublin, A. B.: The Value of Computerized Tomography in the Management of 1000 Consecutive Head Injuries. Surg. Neurol. 7, 171 (1977)
4. Huk, W., Schiefer, W.: Möglichkeiten und Grenzen der Computer-Tomographie beim Schädel-Hirntrauma. Acta Traumatol. 7, 281 (1977)
5. Kricheff, J. J., Lin, J. P., Chase, N. E.: Computer Assisted Tomography in Intracerebral Hematoma and Head Trauma. In: Advances in Cerebral Angiography. p. 353. Ed. by G. Salomon. Berlin–Heidelberg–New York: Springer 1975
6. Lanksch, W., Meese, W., Kazner, E.: CT-Findings in Closed Head Injuries with Special Reference to Contusions. In: Cranial Computerized Tomography. p. 328. Ed. by W. Lanksch, E. Kazner. Berlin–Heidelberg–New York: Springer 1976
7. De Villasante, J. M., Taveras, J. M.: Computerized Tomography (CT) in Acute Head Trauma. Am. J. Roentgenol. **126**, 765 (1976)

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