Assessment of infratentorial Acute Ischemic Stroke with Diffusion-weighted-imaging

Synopsis: Systematic clinico-topographical correlation studies of vertebrobasilar stroke are rare due to limitations of visualization of infratentorial structures and small strokes. We analysed DWI data of 275 patients with acute infratentorial infarction from a stroke center serving a 1 million population. Even minute lesions and multifocal pathology are regularly detected with DWI, allowing exact identification of infratentorial stroke with identification of reoccuring stroke-subtypes, which in turn frequently provides important clues as to the understanding of the clinical deficit and underlying etiology/stroke mechanism. This study provides a data bank on the frequency of infratentorial stroke subtypes and related clinical phenomena.

Background and purpose: Compared to anterior-circulation-stroke, systematic clinico-topographical correlation studies of infratentorial infarcts have been rare due to limitations of visualization of infratentorial structures and small strokes. Uncertainties in clear-cut differentiation of brainstem and cerebellar clinical symptomatology may in part be due to still too vaguely defined topography of infratentorial infarction. Because of high lesion to background contrast, DWI appears particularly well suited for the evaluation of acute infratentorial stroke. We analysed DWI findings in a large number of consecutive patients in regard to the topographical infarct distribution patterns of acute cerebellar and brainstem infarcts.

Patients and Methods From a prospectively collected stroke center data registry serving a 1 million population with 2596 stroke patients (1996-2002), we evaluated 275 patients with acute infratentorial infarction between April 1996 - April 2002. All patients (181 men, 94 women, mean age 65 +/-12,5 years) were examined with a standardised stroke MRI protocol including DWI within 5 hours to 6 days (mean 3,2 d) from symptom onset. Precise infarct topography was determined, relating to topographical maps of arterial supply of the brainstem and cerebellum as suggested by *Tatu et al.* (*1996, Neurology; 47:1125-1135)*. Stroke etiologies were evaluated individually according to the ´stroke mechanism classification criteria´ adapted from Caplan *(Glass et al. 2002, Arch Neurol; Vol59, Mar)*.

Results: A total of 23 different infarct patterns was described. Results were in part corresponding to previous anatomical studies, but new aspects were added. Presumed topographical arterial supply maps matched well the topography of territorial infarcts. Infarct incidence: Most of the infratentorial infarcts were encountered in the brainstem (total of 190/275 patients: 69%), with the majority of these occuring as monolocular brainstem infarcts (146/190: 77%). The pons represented by far the predominant infarct site (106/146: 73%) whereas medullary infarction (19/146: 13%) and isolated midbrain infarcts (21/146 patients: 14%) were less frequent. Compared to brainstem infarcts, cerebellar strokes (total of 108/275 patients, 39%) were more likely to occur in a combined infarct pattern rather than to occur as monolocular pure cerebellar infarct: in 50% (54/108), stroke was multilocular involving noncerebellar structures; in 50% (54/108), infarction was confined to the cerebellum, but in 41% (22/54) more than one cerebellar territory was affected, with only 30% (32/108) of all cerebellar infarcts accounting for monolocular cerebellar infarcts. Within this group, the PICA-territory (14/32: 44%) was the most often affected site, followed by 41% (13/32) of SCA infarcts. AICA-strokes were of higher frequency than reported from previous studies, accounting for 16% (5/32). Considering all cases of strokes with cerebellar involvement (including those multiterritorial combined infarcts) even higher incidence rates were observed: SCA infarcts (67/108: 62%), AICA infarcts (20/108:19%), PICA infarcts (67/108: 62%), again showing a similar frequency of PICA and SCA infarction. Multiple ischemic infarcts within the vertebrobasilar territory occured in 58 patients (58/275: 21%) and combined ischemia in the posterior and anterior circulation territory was found in 17 patients (17/275: 6%). Topographical stroke distribution patterns were identified and categorized: Whereas brainstem infarcts allowed categorization mainly in concordance to presumed topographical arterial supply patterns, cerebellar infarcts, due to larger extension of arterial territories and therefore less homogenous infarct morphologies, necessitated a different approach for classification: a) differentiation of the cerebellar arterial subterritories, b) differentiation of cerebellar strokes, categorizing into complete, partial territorial, circumscribed, very small border zone infarcts and combined infarct configuration patterns. Concomitant MRI/MRA findings in conjunction with results of diagnostic investigations (Doppler/Duplex-ultrasound, echocardiography, ecg, serum-analysis) were evaluated in view of etiopathological considerations and stroke-subtype related main etiopathological mechanisms were investigated.

Conclusion: DWI is most effective for the detection and categorisation of acute ischemic infratentorial lesions, traditionally a region that poses diagnostic difficulties as it can be difficult to pinpoint clinically and is difficult to visualise with CT and T2-weighted MRI. This study provides a large data bank on the frequency of acute infratentorial stroke subtypes and multifocal lesion patterns. DWI allows the detection of even minute lesions as they frequently occur in the medulla or pons. The ability to appreciate previous lesions on T2-weighted MRI in functionally related areas in addition to the acute pathology provides a better understanding of the clinical deficit. This approach should allow more systematic studies in regard to clinico-pathological phenomena and the mechanisms of infratentorial stroke.

Fig. A) Incidence of pure brainstem and pure cerebellar stroke

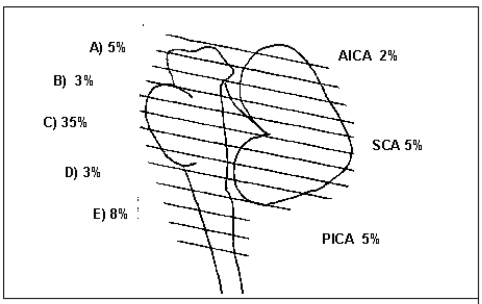
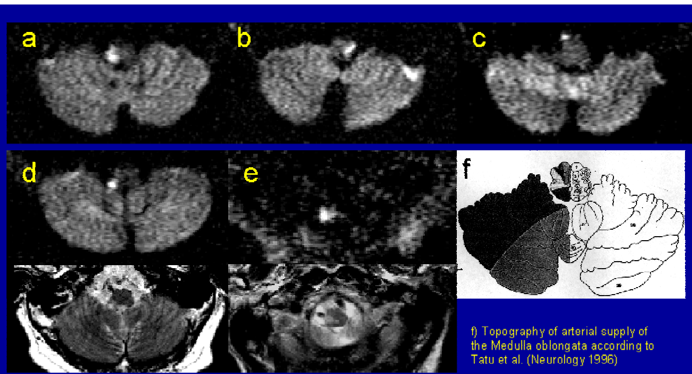


Fig.A) Incidence rates of infratentorial infarcts; on the left: A) Mesencephalon B) Pontomesencephalic junction, C) Pons, D) Pontomedullary transition zone, E) Medulla oblongata; figures: n/275;with 275 = total number of infratentorial infarcts,;on the right: cerebellar infarcts: n/275 (further subcategorization please see text);Multiterritorial infarction within posterior circulation territory: 58/275, Multiterritorial infarction combined with ant. circulation stroke 17/275 (not shown). Lines given show axial slice positions with alignment along the inferior callosal border

Fig. B) Exemplary stroke subtype categorization at the medullary level by evaluation of DWI-data and correlation with arterial supply maps



f) Topography of arterial supply of the Medulla oblongata according to Tatu et al. (Neurology 1996)

Fig.B) Medulla oblongata infarct topographies as depicted by DWI; 5 categories, corresponding to presumed topography of arterial supply according to Tatu et al. 1996 (see f): Stroke categories and frequencies: a) dorsolateral 42%; b) anterolateral 5% c) anteromedial 11%; d) dorsal 5%; e) lateral 37%; (d) and e) with corresponding T2-weighted images below for precise determination of infarct morphology