

# The Significance of White Matter Lucencies on CT Scan in Relation to Cognitive Impairment

A. Steingart, K. Lau, A. Fox, F. Diaz, M. Fisman, V. Hachinski, H. Merskey and the University of Western Ontario Dementia Study Group

**ABSTRACT:** As part of a prospective clinicopathological study a cohort of "normal" elderly volunteers (n = 110) has been investigated with CT scans, psychometric testing (Extended Scale for Dementia) and neurological examination. CT scans were evaluated by a neuroradiologist for the presence or absence of white matter lucencies (WML). WML were defined as patchy or diffuse areas of decreased attenuation involving only white matter and with no change in adjacent ventricles or sulci.

The 12 subjects with WML had lower scores on the ESD than the 98 subjects without WML (mean ESD with WML  $229.5 \pm 14$ ; without WML  $236.7 \pm 8.6$ , t-test  $p < .01$ ) and the difference remains significant even after adjusting for the possible confounding effects of age (ANCOVA,  $P < .043$ ).

**RÉSUMÉ:** Valeur significative des zones brillantes ("lucencies") à la tomographie cérébrale en rapport avec l'atteinte des fonctions cognitives. Une cohorte de volontaires âgés "normaux" (n = 110), faisant partie d'une étude clinicopathologique prospective, a été investiguée au moyen de la tomographie cérébrale, d'une évaluation psychométrique (échelle élargie pour la démence) et d'un examen neurologique. Les examens tomographiques ont été examinés par un neuroradiologiste recherchant la présence ou l'absence de zones brillantes ("lucencies") au niveau de la substance blanche (ZBSB). Les ZBSB étaient définies comme des zones d'atténuation diminuée, diffuses ou en foyers disséminés impliquant seulement la substance blanche sans qu'il y ait de changement dans les ventricules ou les scissures adjacentes.

*Can. J. Neurol. Sci. 1986; 13:383-384*

Evidence of a relationship between the computed tomography (CT) finding of diffuse attenuation in the deep white matter and cognitive impairment is somewhat conflicting. The presence of white matter lucencies has been attributed to watershed infarction, hydrocephalus, Binswanger's encephalopathy and "normal" aging.<sup>1-7</sup> Although studies have reported an increased prevalence of white matter lucencies in the elderly,<sup>1,8,9</sup> controversy remains about the significance of this finding in relation to cognitive impairment. Comparisons across studies are further complicated by the lack of explicit criteria for CT diagnosis of white matter lucencies.

The term leuko-arais (LA) will be used in this paper to denote the patchy white matter lucencies identified on CT. The focus of this paper is to delineate criteria used to differentiate LA from infarcts and to compare the results of psychometric assessment performed on putatively normal elderly volunteers with and without LA.

## METHOD AND RESULTS

As part of a prospective clinicopathological study<sup>10</sup> a cohort of elderly volunteers (n = 105) has been investigated with CT scans, neurological examination and psychometric testing utilizing the Extended Scale for Dementia.<sup>11</sup> Subjects were excluded if there was evidence of dementia<sup>12</sup> or if there was a diagnosis of stroke. CT scans were evaluated for the presence or absence of LA using the criteria listed in Table 1.

The 9 subjects with LA had lower scores on the ESD than the 96 subjects without LA (mean ESD with LA  $227.1 \pm 14$ ; without LA  $237.1 \pm 8$ , t test,  $p < .02$ ).

The sex distribution, educational attainments and other CT findings were not significantly different in subjects with and without LA. However, the subjects with LA had a mean age of  $75.3 \pm 8.2$  which was significantly older than the mean age of  $70.8 \pm 5.4$  for those without LA (t test,  $p < .025$ ). The lower

From the Department of Education & Research, London Psychiatric Hospital, London, Ontario (Drs. Steingart, Fisman, and Merskey) and the Department of Clinical Neurological Sciences, University Hospital, London, Ontario (Ms. Lau, Drs. Fox, Diaz, and Hachinski)

Reprint requests to: Dr. H. Merskey, London Psychiatric Hospital, Department of Education & Research, 850 Highbury Avenue, P.O. Box 2532, Terminal A, London, Ontario, Canada N6A 4H1

**Table 1: CT interpretation — criteria for distinguishing infarcts and leuko-araiosis.**

Infarct	LA
— well demarcated	— ill defined, patchy, diffuse
— wedge shaped	
— usually cortical extension	— white matter only without extension to cortex
— follows specific vascular territory	
— internal capsule, basal ganglia or thalamus may be involved	
— enlargement of ipsilateral ventricle or sulcus	— ventricle and sulcus unchanged locally

scores on the ESD in subjects with LA when compared to subjects without LA remains significant even after adjusting for the possible confounding effects of age, sex, education and infarct on CT (ANCOVA,  $p < .013$ ).

### CONCLUSION

LA is a relatively common finding on the CT of non-demented elderly subjects. We found a prevalence of 8.6% in subjects selected for absence of dementia and without a history of stroke. The other major finding of this study is the demonstration that the presence of LA is associated with a measurable decline in cognitive function. The decline in ESD scores remains significant even after the results are adjusted for the potentially confounding effects of age, sex, education and coexisting infarct on CT.

LA may represent a marker for early vascular dementia. Our results suggest that white matter abnormalities play a role in the development of intellectual decline in the elderly.

### ACKNOWLEDGEMENTS

This study was supported in part by grants from the U.S. N.I.A. (Dr. M.J. Ball), the M.R.C. of Canada (PG 21) and the N.H.R.D.P. of Canada (Dr. Merskey). We thank all the members of the U.W.O. Dementia Study Group for their support and encouragement.

### REFERENCES

1. Kinkel WR, Jacobs L, Polachini I, et al. Subcortical arteriosclerotic encephalopathy (Binswanger's Disease). *Arch Neurol* 1985; 42: 951-959.
2. Caplan LR, Schoene WC. Clinical features of subcortical arteriosclerotic encephalopathy (Binswanger disease). *Neurology* 1978; 28: 1206-1215.
3. Goto K, Ishii N, Fukasawa H. Diffuse white-matter disease in the geriatric population. *Radiology* 1981; 141: 687-695.
4. Lane B, Carroll BA, Pedley TA. Computerized cranial tomography in cerebral diseases of white matter. *Neurology* 1978; 28: 534-544.
5. Loizou LA, Kendall BE, Marshall J. Subcortical arteriosclerotic encephalopathy: a clinical and radiological investigation. *J Neurosurg Psychiatry* 1981; 44: 294-304.
6. Rosenberg GA, Kornfeld M, Stovring J, et al. Subcortical arteriosclerotic encephalopathy (Binswanger): Computerized tomography. *Neurology* 1979; 29: 1102-1106.
7. Huang K, Wu L, Luo Y. Binswanger's disease: Progressive subcortical encephalopathy or multi-infarct dementia? *Can J Neurol Sci* 1985; 12: 88-94.
8. Zatz LM, Jernigan TL, Ahumada AJ Jr. White matter changes in cerebral computed tomography related to aging. *J Comput Assist Tomography* 1982; 6: 19-23.
9. DeLeon MI, George AE, Ferris SH, et al. Pet study of leukoencephalopathy in Alzheimer disease. 23rd Annual Meeting of the American Society of Neuroradiology, New Orleans, Feb. 18-23, 1985.
10. Merskey H, Blume WT, Colhoun EH, et al. Correlative Studies in Alzheimer's Disease. *Prog Neuro-Psychopharmacol & Biol Psychiat* 1985; 9: 509-514.
11. Hersch EL. Development and application of the Extended Scale for Dementia. *J Am Geriatrics Soc* 1979; 26: 348-354.
12. American Psychiatric Association. *Diagnostic and Statistical Manual of Psychiatric Disorders*, 3rd Edition. Washington, D.C. 1980.