IMPACT OF IMAGING DEVELOPMENT UPON LEUKOARAIOSIS DETECTION IN A GROUP OF VASCULAR PATIENTS

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ABSTRACT

This study was performed on a group of 50 patients admitted in 2008 in the Neurology Department, Emergency Hospital Constanta, whose cerebral MRI revealed leukoaraiosis. Our purpose was to correlate leukoaraiosis with associated vascular pathologies. With the help of brain MRI leukoaraiosis was classified in 4 stages, according to severity and extension (Brand-Zawadzki). Stage II was present frequently in patients with acute stroke. Stage III was in patients with chronic vascular lesions. Stage IV in our studied group was found in those with Binswanger disease. We found that severity of leukoaraiosis increased with age. The severity of neurologic symptoms was in direct correlation with the severity of leukoaraiosis. We also found that leukoaraiosis is a risk factor for cognitive decline, and in our study was associated with brain atrophy in 66% of the cases. Presence of leukoaraiosis was also associated with increased risk of stroke recurrence, in our study the recurrence of stroke occurring in half of the cases.

Key words: Leukoaraiosis, vascular lesions, prognosis, cognitive decline

INTRODUCTION

Leukoaraiosis represents a heterogeneous diffuse anomaly of cerebral white matter localized predominantly periventricular, detected by CT scan (hypodensity) or MRI (hyperintensity on T2 weighted images or FLAIR). Leukoaraiosis affects approximately 7% of cases with ischemic stroke, 20% in those with lacunar infarcts, 30-40% of patients with dementia and 2/3 of patients with vascular dementia. Also in old people is in association with vascular risk factors like arterial hypertension (Mike O' Sullivan; *Practical Neurology* 2008).

Pathophysiology: in region with leukoaraiosis, there are areas of demyelination, increased perivascular space, gliosis and axonal loss. Initially it was thought that demyelination was secondary to incomplete ischemia but PET scan revealed the loss as totality of nervous fibers. The same images also appear in obstructive hydrocephalus, disseminated metastasis of white matter and lymphomas.

Cerebral white matter is vascularised by penetrating arteries and arterioles which are branches of larger superficial cerebral arteries. Structural modification of these arteries are as follow: from concentric hyaline deposits of artery wall, to lipohyalinosis (it is referred to severe disorganisation of vascular bed with macrophage presence) and fibrinoid necrosis. In asymptomatic elders the lumen of these arteries are decreased significantly. Pathological studies suggest that leukoaraiosis is one of the manifestations of cerebral small vessels disease. From this point of view it can be explained the relation between leukoaraiosis and lacunar infarcts.

Age and arterial hypertension are associated more frequently with ischemic leukoaraiosis, where

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hypercholesterolemia, diabetes mellitus, and myocardial infarction are associated more frequent with isolated lacunar infarcts. So suggested non-atheromatosis pathogenesis of cerebral small arteries implicated in ischemic leukoaraiosis (Mike O' Sullivan; *Practical Neurology* 2008).

Staging of leukoaraiosis in 4 grades according to lesion severity and their advancement (Brand-Zawadzki et al.) is done with the help of cerebral MRI scan:

- Stage I: hyperintense lesions on T2 weighted and FLAIR images are spot-like and are located in neighborhood of frontal horns of lateral ventricles.
- Stage II: white matter lesions are located around subependymal region of lateral ventricles.
- Stage III: white matter lesion on T2 weighted and FLAIR are the same as in stage II in addition focal spot-like lesion of deep white matter.
- Stage IV: hyperintense white matter lesions on T2 weighted and FLAIR images are extended, fusiform and interconnected.

Objectives: correlation between leukoaraiosis and associated vascular pathologies in a group of 50 patients.

PATIENTS AND METHODS

The study was performed on a group of 50 patients admitted to Neurology Department in 2008, whose cerebral MRI revealed leukoaraiosis.

RESULTS

Causes of admission of these patients through Emergency service in Neurology Department Constanta were as follows:

1. Neurological signs of acute stroke (ischemic or hemorrhagic).
2. Those with known symptomatic atherosclerotic signs: stroke, myocardial infarction, peripheral arterial disease in those that appeared or aggravated gait abnormalities, cognitive abnormalities, phonation or deglutition abnormalities, headache, vertigo, seizures, etc.
3. Those with known vascular risk factors that appeared clinical signs described in 2 (gait abnormalities, cognitive abnormalities, phonation or deglutition abnormalities, headache, vertigo, seizures, etc.).

Risk factors	Acute stroke	Symptomatic atherosclerotic lesions
arterial hypertension	16	8
chronic arterial disease	1	1
atrial fibrillation	3	2
diabetes mellitus	7	3
dyslipidemia	6	3
smoking	10	8
obesity	5	5
increased fibrinogen	10	8
drinking	2	2

Vascular risk factors found in patients with leukoaraiosis in our study are as follow:

From **first group** (those with acute stroke signs on admission) there were 24 patients.

- Acute ischemic stroke:
1. Middle cerebral artery in 15 cases
2. Pontine in 4 cases
3. Cerebellar in 2 cases
- Acute hemorrhagic stroke in 3 patients.

Cerebral MRI images revealed acute ischemic or hemorrhagic stroke, leukoaraiosis, mixed cerebral atrophy in 14 cases and old ischemic stroke in 7 cases.

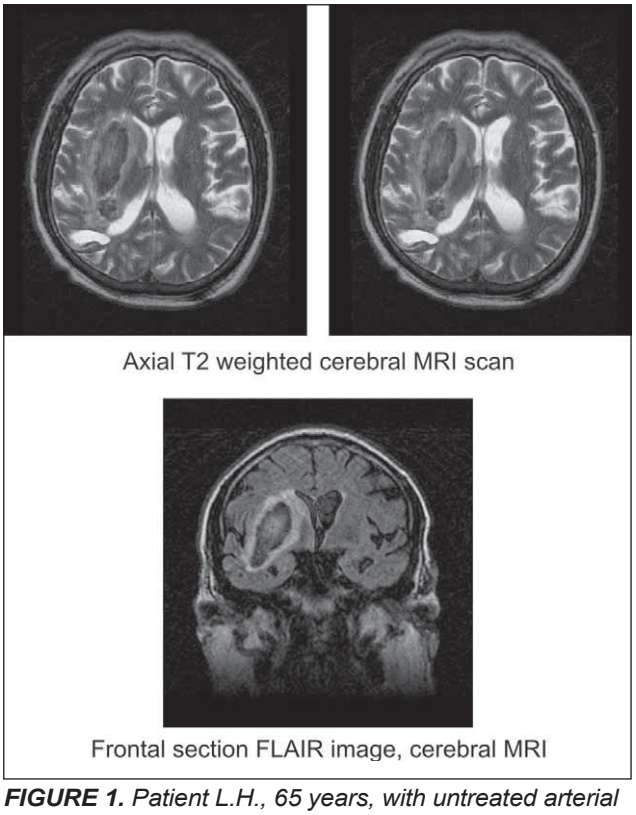

FIGURE 1. *Patient L.H., 65 years, with untreated arterial hypertension, smoker, admitted for left hemiplegia suddenly occurred. Cerebral MRI scan shows primary right temporo-parietal primary intracerebral hematoma, mixed cerebral atrophy, leukoaraiosis stage II.*

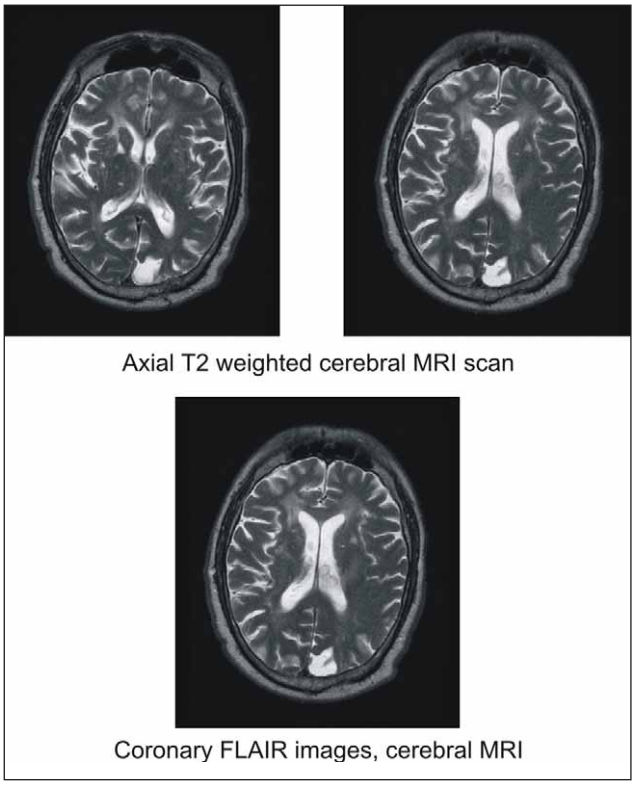

FIGURE 2. *Patient P.I., 70 years, with arterial hypertension, diabetes mellitus, with left posterior cerebral arterial ischemic stroke in the last 3 years, admitted for right hemiparesis and mixed aphasia. Cerebral MRI shows acute left middle cerebral arterial stroke, old posterior cerebral arterial stroke on left side and leukoaraiosis stage III.*

In the **second group** there were 16 patients who had history of symptomatic atherosclerotic lesions: stroke, peripheral arterial disease or myocardial infarction.

All of them had instead of old lesions on MRI, leukoaraiosis and mixed cerebral atrophy.

Neurologic symptoms that determined them or their nurses giving staffs to address the neurologist specialists were:

- Gait abnormalities in the first place (12 cases)
- Chronic central type vertigo (3 cases)
- Phonation and deglutition difficulties (4 cases)
- Severe cognitive disturbances (4 cases)
- Epileptic seizures (3 cases)
- Sphincter abnormalities (14 cases)
- Headache (14 cases).

In the **third group** there were 10 patients known with vascular risk factors (arterial hypertension, chronic arterial disease, congestive heart failure, diabetes mellitus, dyslipidemia, smoking, obesity, increased fibrinogen level, heavy drinking, family history of early death due to stroke), majority without ambulatory treatment.

They presented leukoaraiosis, cerebral atrophy, old cerebral ischemia and lacunar infarcts. Clinical symptoms were as in the former group.

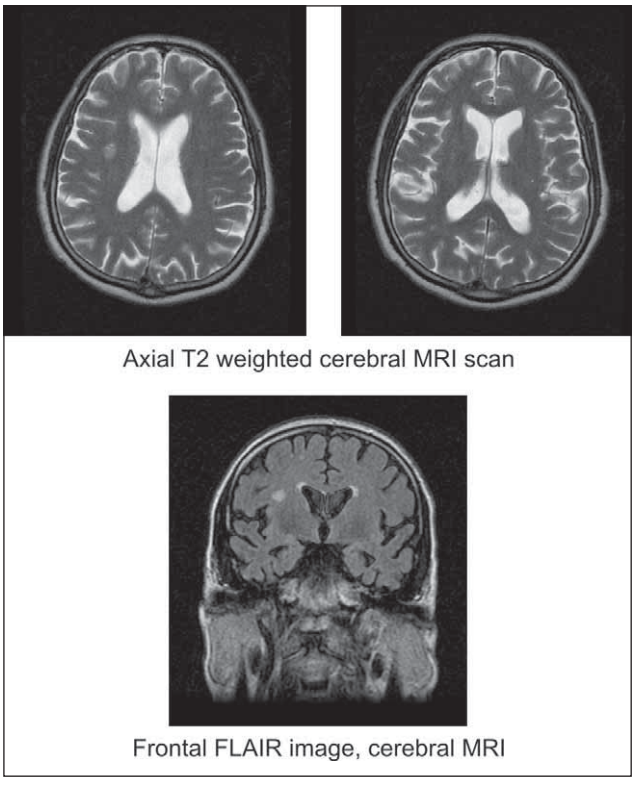

FIGURE 3. *Patient S.B., 60 years, smoker, history of myocardial infarction, admitted for vertigo, memory disturbances and headache. MRI scan shows: leukoaraiosis stage I, deep parietal lacunar infarct on right side.*

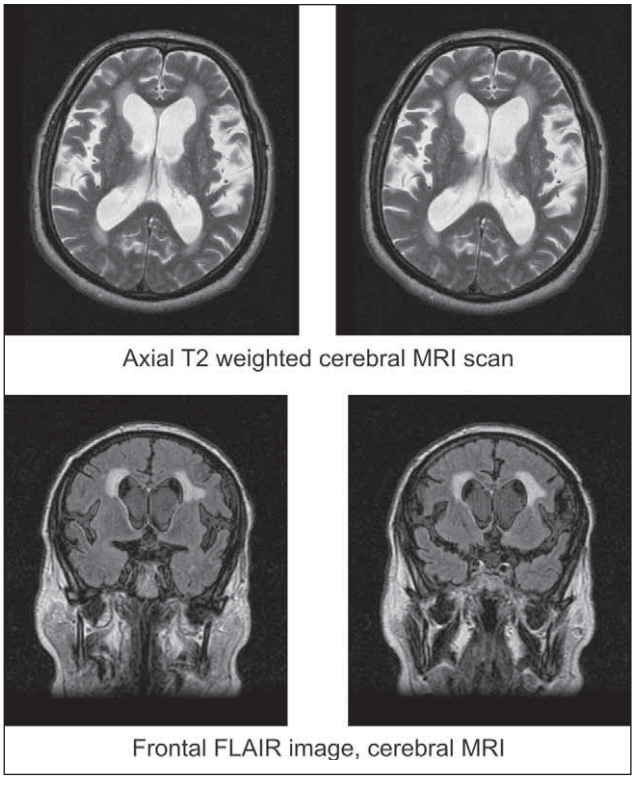

FIGURE 4. *Patient C.N., 63 years, with arterial hypertension, diabetes mellitus, peripheral arterial disease, gait abnormalities for one year, frequent falling and memory disturbances. Cerebral MRI scan shows: mixed brain atrophy and leukoaraiosis stage II.*

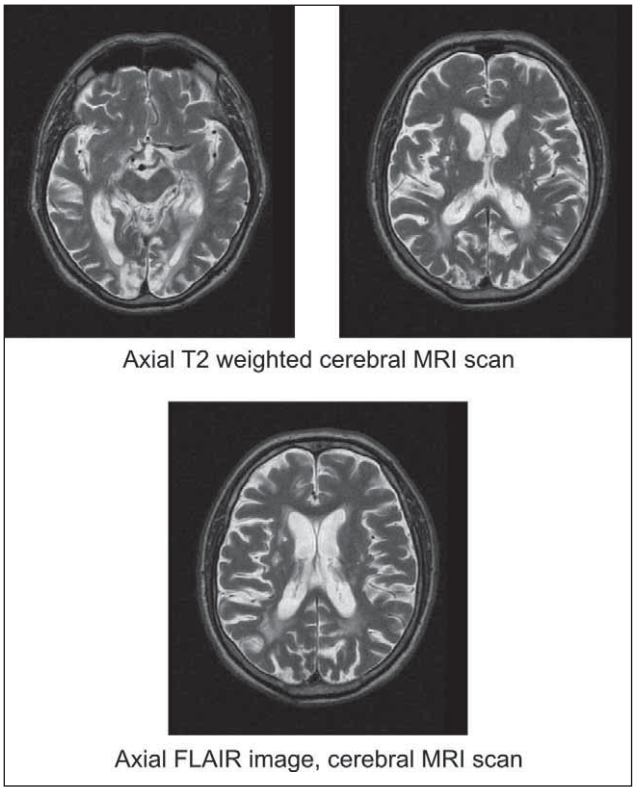

FIGURE 5. *Patient M.G., 71 years, known with arterial hypertension, dyslipidemia, history of 2 bilateral PCA Infarcts (first one in 2004 and the second in 2008), cortical blindness, with sphincter abnormalities for some months, gait and memory difficulties aggravated. Cerebral MRI scan shows: mixed brain atrophy, leukoaraiosis stage II-III, bilateral old occipital ischemic lesions.*

Binswanger disease: subacute atherosclerotic encephalopathy (O. Zaidat 2008) or subacute leukoencephalopathy (Adams 2005) which collects the imagistic signs of leukoaraiosis and clinical signs of subcortical dementia (fatigue, bradipsichia, attension deficit, apathy). Associated with gait abnormalities (gait apraxia) and pseudobulbar state (swallowing and phonation difficulties), vertigo, urinary incontinence, epileptic seizures.

Briefly, Binswanger disease is represented by leukoaraiosis, a patient with dementia (in which other causes are not determined) and history of arterial hypertension.

Binswanger disease together with multi-infarct dementia and CADASIL syndrome are the 3 forms of vascular dementia.

In our group Binswanger disease was found in 4 cases.

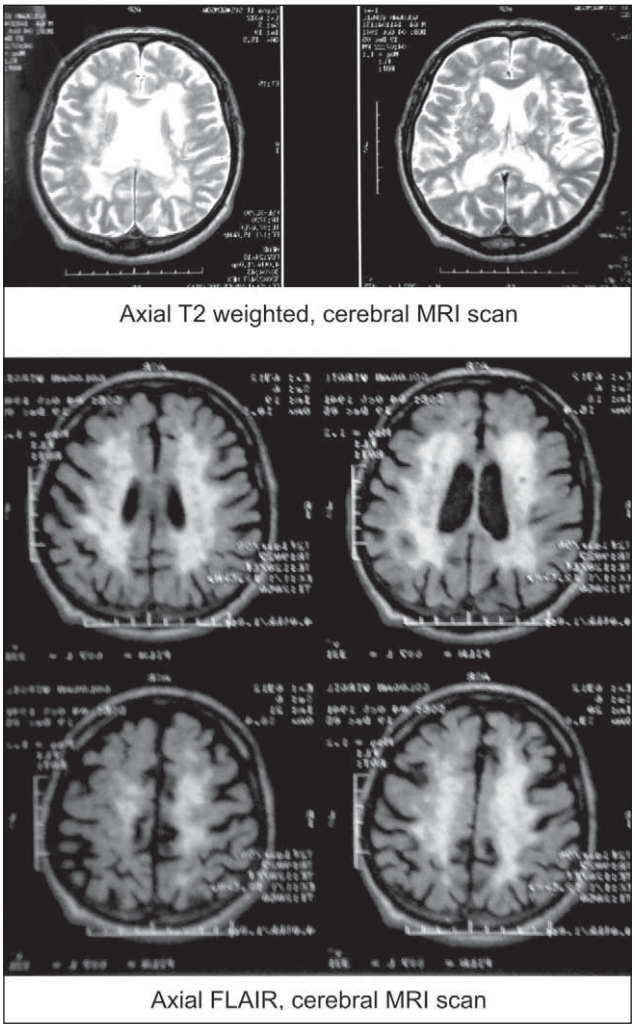

FIGURE 6. *Patient G.V., 68 years, history of untreated arterial hypertension of 10 years, with gait apraxia, dementia, phonation abnormalities for about one year. Cerebral MRI shows mixed brain atrophy and leukoaraiosis stage IV.*

- **Stage I leukoaraiosis** was found in 8 cases: 5 cases with acute stroke and 3 with old stroke. These patients didn't present any

Classification of patients according to age group and to stages of leukoaraiosis is as follows:

Group of age	Leukoaraiosis stage I	Stage II	Stage III	Stage IV	Total
<49 years	0	3	0	0	3
50-59 years	4	9	1	0	14
60-69 years	4	8	5	2	19
70-79 years	0	3	8	0	11
80-89 years	0	0	2	1	3
Average age	59 years	65 years	69 years	72 years	-

specific clinical manifestations. Average age was 59 years.

- **Stage II leukoaraiosis** was found in 23 cases, average age was 65 years. These patients were classified to all 3 groups (acute stroke, those with symptomatic atherosclerotic lesions: stroke in association with myocardial infarction or peripheral arterial disease of lower limbs or those with known vascular risk factors). Patients with acute stroke and leukoaraiosis dominate this subgroup.
- **Stage III leukoaraiosis** was found in 16 cases, average age was 69 years, predominated by the patients with chronic vascular lesions.
- **Stage IV leukoaraiosis** was detected in 3 cases, average age was 72 years; together with a patient with stage III leukoaraiosis these 3 cases had Binswanger disease.

Imagistic differential diagnosis of leukoaraiosis are:

- **Normal pressure hydrocephalus** – clinical manifestations are the same (triads of dementia, gait abnormalities and urinary incontinence); therapeutic test with improvement by lumbar puncture evacuation is very good.
- **Multiple sclerosis** – the age of the patient, clinical evolution and therapeutic benefits are important.

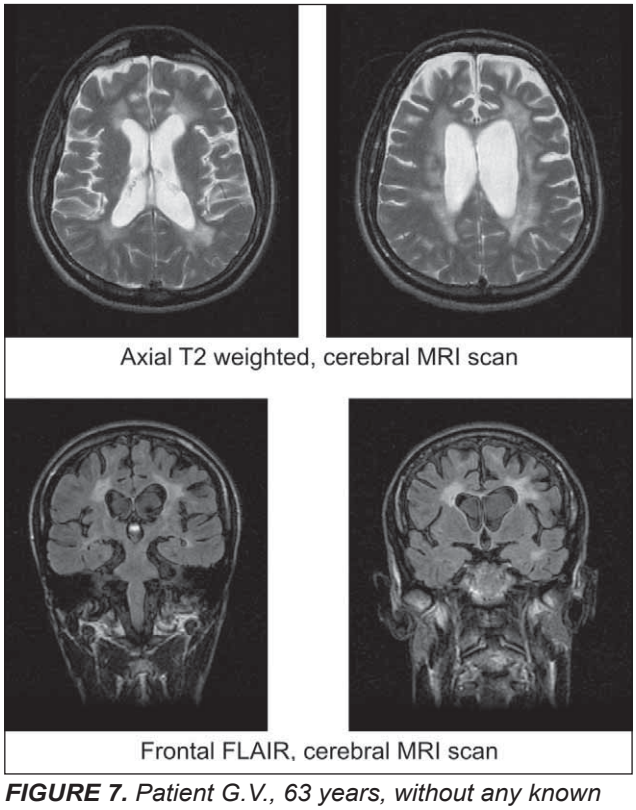

FIGURE 7. *Patient G.V., 63 years, without any known pathologic history, admitted for urinary incontinence, memory deficit, gait abnormality in the last 6 months with progressive worsening.*

Cerebral MRI scan shows brain atrophy, ventriculomegaly, periventricular diffuse hyperintense T2 weighted and FLAIR.

Repeated lumbar tab was done (20ml CSF/ day for 5 consecutive days), with subsiding of symptoms. The patient was sent to Neurosurgery department where he received ventriculo-peritoneal shunt.

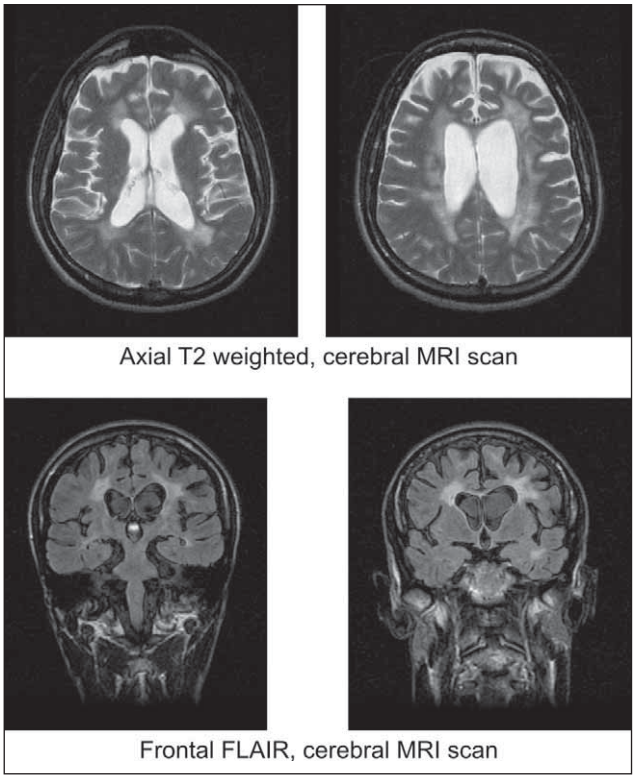

FIGURE 8. *Patient E.P., 38 years, diagnosed with secondary progressive multiple sclerosis, with spastic paraplegia at present, bicerebellar syndrome and severe ataxia, urinary incontinence, EDDS 9. First attack of multiple sclerosis was at the age of 16. He did not access to therapy with beta interferon or glatiramer acetate. Cerebral MRI scan shows cerebral atrophy and diffuse periventricular hyperintense lesions on T2 weighted and FLAIR.*

CONCLUSIONS

- With the help of MRI scan leukoaraiosis was classified in 4 stages, according to severity and extension (Brand-Zawadzki).
- Stage II was present frequently in patients with acute stroke.
- Stage III was in patients with chronic vascular lesions.
- Stage IV in our studied group was found in those with Binswanger disease.
- Severity of leukoaraiosis increases with age.
- Severity of neurologic symptoms is in direct proportion with severity of leukoaraiosis.

- Leukoaraiosis is a risk factor for cognitive decline, in our study this affect was accentuated due to association with brain atrophy in 66% of all cases.
- Presence of leukoaraiosis is associated with increased risk of stroke recurrence, in our study half of the cases.

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