

# Regional cerebral blood flow as a diagnostic tool in frontal lobe dementia of non-Alzheimer type

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## ABSTRACT

This paper concerns about regional cerebral blood flow measurements in patients suffering from frontal lobe dementia. The purpose of the study was to contribute of drawing a picture of a diagnostic asset, help making an early contribution to distinguish different kinds of dementia. The 25 female and 18 male patients are a part of The Longitudinal Dementia Study in Lund. Their rCBF measurements have been thoroughly examined to possibly find blood flow changes in particular areas in the brain. The result shows noticeable focal impairments in the frontal and fronto-temporal areas, mostly bilaterally, as well as severe subnormal blood flow levels in 18 patients. This makes an important platform for further research.

Key words: Frontal lobe dementia, regional Cerebral Blood Flow, early diagnose

## **INTRODUCTION**

In neuropsychology researchers are examining the relationship between the brain and behaviour, hereunder psychological functions. The research can be divided into two main areas:

- 1) Research of the functional organization of the healthy brain
- 2) Research of patients with different diseases and damages that affect the functions of the brain.

### **Definitions of dementia**

Dementia has been defined in different ways and some of them are mentioned below. According to DSM-III (American Psychiatric Association, 1987) dementia contains a long-term impairment, at least six months, of mental functions, it particularly concerns with the memory, the will, judgement, orientation ability, practical sense and language-dysfunctions.

Wells in Lezak (1995) consider dementia to be “The spectrum of mental states resulting from diseases of man’s cerebral hemisphere in adult life”.

In Lezak (1995) is also found a narrower and more common used definition of dementia as global cognitive decline includes several criteria: Global implies impairment in more than one aspect of cognitive functions, always including memory dysfunctions, and personality alterations may also contribute to the diagnosis. Decline indicates that this is an acquired condition thereby excluding the mental dullness of retardation. In addition, the patient must be in a clear state of consciousness (awake and alert) thus distinguishing dementia from delirium, stupor or other states of altered consciousness. Additionally dementia typically refers to conditions that are both progressive and irreversible.

### **Degenerative disorders**

As shown above, the diagnosis of dementia is often based on clinical criteria. There is however growing evidence that persons affected by dementia suffer from degenerative brain disorders. Many diseases process progressive deterioration of brain tissue and of behaviour

(Johanson, et al. 1989) Nerve cell death is central to the manifest of neurological and behavioural changes of degenerative neurological diseases. The selective nature in which nerve cell death occur gives them characteristic symptoms (Gustafson et al, 1977., Brun, 1994). For the most part their aetiology is unknown or only partially comprehended. Together they affect increasing portions of the over-65 population: from 6% of persons at 65 and younger, 20-30% of the over 80-age-group (Gustafson, 1987).

With the growing proportions of the elderly persons in the most industrialized countries, an escalating number of demented persons – and burdened caregivers and care-facilities – must be anticipated (Gurland and Crass, 1986).

Dementia of non-Alzheimer type usually affects the frontal parts of the brain.

The frontal area of cerebral cortex can according to Luria (1966) be divided in to three main regions:

1. The premotor division
2. The prefrontal convexity
3. The orbital and mediobasal regions.

The three major divisions of the frontal lobes differ functionally although each is involved more or less directly with behaviour output.

All these three areas are closely related to the limbic structures, which contain evolutionarily earlier developed structures. The limbic system, with the hippocampus and amygdale, has been associated with a variety of different functions, e.g. emotion, inhibition, learning and memory. Disturbances in each of the three frontal areas of the brain may lead to different types of functional changes.

#### 1. Premotor division

This division is situated just anterior the precentral area, the premotor cortex. The most posterior, precentral, division lies in the first two first ridges in the front of the central sulcus. This is the primary motor cortex, which mediates movement (not isolated muscles) and as such has important connections with the cerebellum, the basal ganglia, and the motor division of the thalamus.

It has been identified as the site in which integration of motor skills take place. Lesions here do not result in the inability to move, but rather disrupt the integration of the motor components of complex acts.

Lesions here result in weakness or paralysis of the corresponding body parts (J.F Stein 1988).

Damage in the premotor division of the cortex produces disturbances in the kinetic organization and inhibition of movements, shifts from one movement to another and transformations of individual motor acts into sequentially organized skilled movements (Luria 1966; Kolb and Whishaw 1990).

The cortex and underlying white matter of the frontal lobes is the site of interconnections and feedback loops between the major sensory and the major motor systems, linking and integrating all components of behaviour at the highest level (Fuster 1980, Pandoya and Barnes 1987, Stuss and Benson 1984).

## 2. Prefrontal convexity

Pathways carrying information about the external environment from the posterior cortex and information about internal states from the limbic system converge in the anterior portions of the frontal lobes, are the prefrontal cortex.

The anterior frontal lobes are where already correlated incoming information of all sources – external and internal, conscious and unconscious, memory storage and visceral arousal centres - is intergrated and enters outgoing activity.

Lesions in the prefrontal regions of the cortex produce inability to compare the plan of an action with the outcome actually obtained. (This loss of planning and strategy is clearly demonstrated in the present patients). Further, a patient with this form of damage seems to have lost the ability for critical evaluation

Frontal dynamic dysphasia (aspontaneity to speech) may be present as well as echolalia.

## 3. Orbital and mediobasal regions

A quite different picture is observed when the damage affects the orbital parts of the cortex. This area has rich connections, of both afferent and efferent type with the limbic system, and thereby with the hypothalamus, involved in almost all aspects of behaviour including emotional behaviour. This is probably one important explanation why frontal-orbital

dysfunction gives affective symptoms. Personality changes are well-known symptoms in patients with frontal lobe lesions. Emotional unconcern, inertia, loss of selectivity, loss of planning, unawareness of mistakes, preservations and stereotypes are examples seen in patients with FLD and Picks disease.

There are several statements about the frontal lobes:

“ The human prefrontal cortex attends, integrates, formulates, executes, monitors, modifies and judges all neuron system activities” (Stuss and Benson 1987).

Perecman (1987) refers to it as the “seat of consciousness”

Miller and his colleagues called it “ the organ of civilization”, a definition that speaks to the fragility of complex behavioural patterns and socially required attitudes in the damaged brain (Goldberg and Bilder, 1987) and to its central role in the normal experience of self (Stuss 1991).

### **Methods for examining the brain**

Computer Tomography (CT) and Magnetic Resonance Imaging (MRI) are useful techniques for reconstructing different densities and constituents and internal structures into shadow pictures of the intra-cranial anatomy, and also traditional x-ray of the skull is an asset. There are structural methods, such as previous mentioned CT and MRI, and those that measure the functional aspects, such as Positron Emission Tomography (PET), functional Magnetic Resonance Imaging (fMRI) and regional Cerebral Blood Flow (rCBF). The latter method will be described in Methods.

The brain lies protected by the surrounding cranial bones, and its afferent and efferent vessels are difficult to reach. These facts have given rise to development of various indirect methods for clinical estimates of the cerebral blood flow. (Höedt-Rasmussen, 1966).

Neuropsychological differences between the degenerative disorders, as Pick’s disease, FTD and Alzheimer’s disease (AD) show up in early stages before the disease has become so widespread as to nullify them. By the time these various diseases have run much of their course, their victims tend to share many behavioural features.

Prominent among these are for one psychosocial regression, which is the disorder of attention (such as inattentiveness) and the inability to concentrate or track mentally.

A behavioural feature is also distractibility, which is apathy with impaired capacity to initiate, plan and execute complex activities, and also the full spectrum of memory disorders. In the long run, most degenerative conditions become neuropsychologically indistinguishable. Frontal-lobe-dementia (FLD) affects patients at an early age, about 45-50 years old. In this kind of dementia memory dysfunction is less pronounced compared to AD. Instead there is a severe change in personality, concentrations-skills, social abilities, motivation and reasoning. This is therefore often confused with psychiatric diseases, like psychosis and depression (The Manchester-Lund Criteria 1994).

Language and visual perception are usually not impaired the first couple of years, but when the disease expand and spread to other parts of the brain, these functions can also be affected.

FLD affects more women than men. The symptoms reflects that the degeneration usually do not spread and settle in other parts of the brain, but remain in areas important for social skills, reasoning, judgement and the ability to initiate, which are located in the frontal-lobes.

When the brains are studied post-mortem, there are usually found two types of microscopically abnormalities:

- 1) FLD (frontal-lobe dementia), clinical FTD (fronto-temporal dementia).
- 2) Pick's disease (PD) with its balloon cells.

The first one, FTD, represents alone about 80% of the cases. These are called non-specific because there are no found identifiable particles. Although there are clear noticeable changes in the cells, and also that cells have been degenerated.

PD, on the other hand, does have identifiable microscopically abnormal particles called Pick's bodies. These cells contain protein materials. This form represent 20% of the cases and are sometimes referred to as a subtype of FLD ([www.brain.northwestern.edu](http://www.brain.northwestern.edu)).

### **Frontal lobe degenerations: Pick's disease and frontal lobe dementia (FLD)**

#### *Risk factors:*

An autosomal dominant inheritance pattern involves from 20% to 50% of Pick's patients, although most cases are sporadic (Lishman 1987). The finding of a greater than usual incidence of head trauma occurring within four years prior to onset of Pick's disease suggest that head trauma may be a contributing factor, but prior head trauma is still relatively

uncommon (12% in a series of 60 patients) and thus only be a weak casual factor, if any. Frontal lobe dementia too, appears to be transmitted as an autosomal dominant disease, with dementia involving a first-grade relative in about half of these patients (Neary and Snowden 1991).

#### *Neuroanatomy and pathophysiology:*

The parietal and occipital lobes remain unaffected in most cases with atrophy concentrated in the temporal and frontal neocortex – excepting the posterior one-half to two-thirds of the superior temporal gyrus, which is also typically spared.

There are mostly bilateral changes, but even cortical atrophy can occur asymmetrically.

As for subcortical structures, the hippocampus is almost never affected, the cerebellum almost always escapes the disease, while the amygdala becomes involved early and universally.

Thalamic and basal ganglia atrophy are common.

At the cellular level, neuron loss is replaced by proliferating nonneuronal cells, normally found in brain tissue (astrocytes and glial-cells). The presence of specific types of abnormal cells (Pick's and balloon cells) helps to confirm the diagnosis.

The tangles and plaques associated with Alzheimer's disease are absent. While the nucleus basalis of Meynert is reduced in size, this reduction is not as great as found in Alzheimer patients. A marked cholinergic deficiency would be unusual. This disease has no distinguishing electroencephalographic pattern, as in EEG is usually normal.

In FLD, the frontal and temporal lobes sustain significant atrophy as do structures in the corpus striatum, while the thalamus, cerebellum and brain stem are among those structures that appear intact at gross inspections (Moss, Albert, and Kemper 1992, Neary and Snowden 1991).

Frontal blood flow is significantly reduced as in frontal areas (Neary, Snowden, et al, 1988).

#### *Cognition*

In both conditions, cognitive alterations typically follow personality and behavioural changes, although this is not always the case. (Moss, Albert, and Kemper, 1992). Formal assessment is not always possible with these patients, even early in their course, as their personality changes and behavioural disturbances may make it difficult to engage their cooperation.

When cognitive impairments do become evident, speech disorders are prominent. (Neary and Snowden, 1991). They may present voluble, but empty speech, or in slow, dysfluent

production. Paraphasia and neologisms are not uncommon but syntactical structures tend to remain, at least for a while. (Lezak 1995).

Dysnomia, with both retrieval and confrontation naming impaired, is a regular feature of Pick's disease. As these diseases progress, comprehension become increasingly defective and ultimately these patients become mute and unresponsive.

Loss of self-awareness shows up in lack of appreciation of their impaired condition. Yet memory deficits are not prominent (Neary and Snowden, 1991) - behaviourally these patients continue to be oriented and to maintain routines during the early stages of the disease, for example nor are visuospatial deficits apparent (Neary and Snowden, 1988).

Arithmetic skills may be relatively preserved. Executive disorders and abstraction and reasoning deficits are among the distinguishing characteristics of these conditions (Moss, Albert, and Kemper 1992).

#### *Personality and Psychosocial behaviour*

Initial symptoms typically appear in "frontal lobe" kinds of personality changes, such as poor judgement, social disinhibition and impulsivity, along with apathy or impaired capacity for sustained motivation (Lishman, 1987).

Affectively, these patients tend to be blandly inappropriate. A particular characteristic feature is a Klüver-Bucy-like syndrome, probably associated with amygdala degeneration (Lezak 1995). Thus these patients tend to become impulsive, hyperoral with indiscriminate eating, and may display compulsive and seemingly meaningless tactile searching.

Frontal lobe dementia patients, too, experience appetitive changes which typically appear as gluttony, particularly in the early stages (Neary and Snowden, 1991). Utilization behaviour is also a typical feature.

#### *The disease process*

These diseases follow a steadily downhill course, but individually rates of decline may differ greatly (Neary and Snowden 1991). In the initial stages the disinhibited behaviour and poor judgement predominate in both conditions, although language impairments may herald disease (Lezak 1995).

Incontinence may appear relatively late in the course of Pick's disease (Lishman, 1987).

Progressive apathy, blunted affect, and cognitive dysfunction characterize the middle stages.

In the late stages many patients display some motor rigidity. The deteriorative process ends as a terminal vegetative state.

Duration of these diseases may be anywhere between two and 17 years (Neary and Snowden, 1991).

### *Diagnosis*

The chief diagnosis problem is differentiating frontal lobe degenerations from Alzheimer's disease, as many of the verbal defects are similar. Even though FTD patients mainly suffer with expressive dysphasia as a result of damage in Broca's area. AD patients, with typically damage in Wernicke's area, moreover suffer with receptive dysphasia. Other similarities are poor judgement, apathy, and irritability or affective flattening that can be symptoms of both conditions. Although in AD this usually occurs late in the course. Alzheimer disease patients mainly have focal impairments in the temporal, parietal and parts of the occipital areas. Moreover, the neuropathological alterations of Alzheimer's disease may encroach on the frontal lobes or the frontal projections routes, producing a mixed diagnostic picture. However, in the early stages socially inappropriate behaviours with relatively intact cognitions, including memory, can help distinguish these diseases, FTD/PD against AD, from other dementia disorders.

Au and her colleagues point out in Lezak (1995) that, despite the many similarities in speech disorders, Pick's differ from Alzheimer's disease in its slow non-fluent or paraphasic qualities, while speech output of frontal lobe dementia patients decreases.

By the middle stages of Pick's disease the appearance of Klüver-Bucy-like behaviours will make the diagnosis more obvious in most cases. Visuospatial orientation of frontal lobe dementia patients remains adequate almost to the end (Neary, Snowden, et al 1988). The end stages for all three diseases are about similar.

### **The Lund-Manchester Criteria**

To address the need for more accurate clinical identification researches in Lund, Sweden and Manchester, England published in 1994 a consensus statement (The Lund and Manchester Groups – Consensus statement) on the basis of several decades of combined clinical and neuropathological experience, outlining the clinical and neuropathological characteristics of FTD. The clinical criteria set out core diagnostic features, characteristics of the disease, supportive features and diagnostic exclusion features. Core features identify characteristics of the behavioural disorder, affective symptoms, and the nature of the speech disorder, the

preservation of spatial orientation and praxis and findings on EEG, brain imaging and neuropsychology.

Within the behavioural domain, features comprise early loss of personal and social awareness, disinhibition, mental rigidity and inflexibility, hyperorality, stereotyped and preservative behaviour, utilization behaviour, distractibility, impulsivity and I persistence, and loss of insight.

A pathological distinction is made between the two main histological types. The term “Pick-type” is adopted to refer to the gliotic form of histology in which there is intense astrocytic gliosis involving all cortical layers and inflated neurones (Pick cells) and inclusions (Pick bodies) may be present. The term frontal lobe degeneration (FLD)-type is used to refer to the microvascular form in which there is a nerve cell loss and spongiform change (microvacuolation), with relatively mild astrocytic gliosis affecting only the outer (three) cortical layers and inflated neurones and inclusion bodies are absent.

### **AIM**

The present study has a purpose to report the use of regional cerebral blood flow as a diagnostic tool in dementia of non-Alzheimer type. On-going research in this area concerns about early diagnose, as a contributing assessment to this increasing medical problem.

## **MATERIAL AND METHOD**

### **The patient group**

The present patient group constitutes a part of a larger material of deceased and post-mortem analyzed patients from the longitudinal dementia-study in Lund. In this study researchers from several scientific areas, have investigated large groups of demented patient over three decades. The purpose of the Lund dementia project is to discover different forms of dementia at an early stage, allowing the use of slow-down medicine, especially in AD, to have an earlier set in. The patients have been followed up with regular intervals with clinical evaluations, neuropsychological investigation, EEG, and rCBF measurements. With this design it has been possible to study early clinical, neuropsychological and neurophysiological findings in different types of dementia and to relate these findings to the autopsy later on.

Table I: Age at disease onset and death

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
ONSET	43	30	84	55,3953	11,01760	121,388
DISEASED	43	38	85	62,6744	10,09413	101,891
Valid N (listwise)	43					

The group consisted of 43 patients with a mean age of 55,4 years (range 30-84) at the onset of the disease. The mean age of death was 62,7 years (range 38-85), while mean duration was seven years.

25 women and 18 men were included in the present study. It is a heterogenic patient group who have been thoroughly tested both neurophysiologically and neuropsychologically at several occasions. The patients have been referred to a psychiatric department due to symptoms indicating dementia. They show the typical clinical characteristics of FLD and/or Pick's disease. The rCBF has been extensively studied in 39 of the 43 cases. In this, study 29 patients with a FLD diagnosis, 5 patients with a Pick's disease diagnosis and 9 patients with a mix diagnosis at autopsy in whom the rCBF pathology was interpreted (as well as the clinical investigations) as indicating FLD.

The mix diagnosis consists of 7 mix of FLD and PD diagnosis, 1 Vascular dementia (Vad) diagnosis and 1 mix of FLD and some other kind of not-identified dementia diagnosis.

Only 39 of the 43 patients are included in this paper, due to three incomplete journals and one patient who denied going through a rCBF measurement.

The patients have had rCBF measured from 1 to 6 times. To equal the patient's terms, only their last rCBF measurements have been considered at this time.

## Method

### *Regional Cerebral Blood Flow*

The measurement of regional Cerebral Blood Flow (rCBF) reflects the brain's metabolic activity indirectly as changes in the magnitude of blood flow in different brain regions, providing relatively inexpensive means for visualizing and recording brain function (Hagstadius 1989, Näätänen 1988, Risberg 1986, 1989, Smith and Fetz 1986).

rCBF measures the blood flow in the brain, the local blood flow in one or several of the areas in the brain. The rCBF can be measured by the non-invasive  $^{133}\text{Xe}$  inhalation method as described by Obrist et al, (1975) and further developed by Risberg (1989). This method gives information about the blood flow in superficial cortical areas. The subject inhales a mixture of the substance and air, while lying down, for one minute via a facemask with a microphone, followed by 10 minutes of normal air breathing. The total time interval between measurements is approximately 20 minutes. The inert gamma-emitting tracer diffuses from arterial blood and venous blood. Blood flow values are then calculated from the rate of clearance of the isotope also considering changes of the arterial concentration of  $^{133}\text{Xe}$ , the latter estimated from the isotope concentration in end-tidal air, sampled from the facemask. The arterial  $\text{PCO}_2$  was estimated from end-tidal  $\text{CO}_2$  concentration.

The rCBF results from the different conditions are transformed into interpolated, colour-coded flow maps for the subject, displaying regional in percent of mean flow level (distribution values)

rCBF is a clinical qualitative method for measuring regional blood flow and can be a useful guideline for identification of cases where suspected frontal lobe degeneration.

Ingvar et al (1965) found that in normals there are only very small differences between the blood flows in the different regions of one hemisphere.

The regions measured in rCBF are as follow: ([www.medphys.ucl.ac.uk](http://www.medphys.ucl.ac.uk))

- 1) Right frontal area
- 2) Left frontal are
- 3) Right temporal area
- 4) Left temporal area

There are possible to measure other areas as well, although this is not relevant at this point in the study.

But how do rCBF measurements appear in patients with a degenerative disease? Are there any typical features in the cortical activity? Where, if anywhere, is the blood flow being noticeable changed?

## RESULTS

### Cortical activity in the present patients

- 18 patients had a subnormal CBF-level
- 2 patients were in the upper part of the normal zone
- 6 patients were in the lower part of the normal zone
- 4 patients had a focal impairment in the right area of the frontal lobe
- 15 patients had a focal impairment in both the right and the left parts of the frontal lobe
- 7 patients had a focal impairment in the left part of the frontal lobe
- 1 patient had a focal impairment in the right part of the fronto-temporal lobe
- 8 patients had a focal impairment in both the right and the left parts of the fronto-temporal lobe
- 2 patients had a focal impairment in the left part of the fronto-temporal lobe
- 0 patients had a focal impairment in only the right prefrontal area
- 7 patients had a focal impairment in both the left and the right parts of the prefrontal area
- 1 patient had a focal impairment in the left prefrontal area
- 3 patients had a focal impairment in the right part of the temporal lobe
- 4 patients had a focal impairment in both the left and the right parts of the temporal lobe
- 2 patients had a focal impairment in the left part of the temporal lobe

<b>Frontal area</b>	Number of patients	Diagnosis
Bilateral	22	1, 2, 3
Right	4	1, 2
Left	8	1
<b>Temporal area</b>		
Bilateral	4	1
Right	3	1
Left	2	1
<b>Fronto-temporal area</b>		
Bilateral	8	1, 2, 3
Right	1	1
Left	2	1

Table II: rCBF changes in patients with frontal lobe degeneration of non-Alzheimer Type

Diagnosis 1 equals FLD at autopsy

Diagnosis 2 equals Pick's Disease at autopsy

Diagnosis 3 equals a mixed form of dementia at autopsy

This shows that the patients with Pick's Disease at autopsy showed focal impairment in the bilateral frontal area, the right frontal area as well as the bilateral fronto-temporal area.

Patients with a mixed diagnosis at autopsy showed focal impairment in the bilateral frontal area as well as in the bilateral fronto-temporal area.

The FLD patients are represented in all of the other areas measured at rCBF in the present study.

### **A case report**

This patient was a man who had his disease onset at 44 years of age and died three years later at the age of 47. He was a divorced engineer with four children. The patient had a prior healthy medical history, before he slowly started to develop personality-changes. This expressed itself as being restless, quit cooking and tidying, as well as gaining a lot of weight in a short period of time. The patient also heavily increased his use of cigarettes. These are all typical features of a starting degenerative disease with its slowly development without any obvious cause.

Clinically the patient quite fast progressed to dementia with the restlessness, imbalanced motor functions, and no verbal contact, heavily eating everything in sight, such as flowers, paper etc, which confirms the earlier mentioned indiscriminating eating.

This fact caused the outcome that the patient actually died caused by suffocation after eating inedible subjects. The patient suffered also from incontinence of urine and stools due to his disease, which again is a typical feature of this condition.

This patient's rCBF measurements showed the most profound focal pathology ever seen by the Lund research team. The rCBF showed heavily focal impairment in the frontal lobes bilaterally as well as an extensive subnormal rCBF-level. The autopsy revealed an extensive form of Pick's disease.

## DISCUSSION

The results show that the frontal cortical degeneration and the symptoms of frontal lobe dysfunction present in patients with FLD and Pick's Disease are paralleled by a progressive reduction of the blood flow level.

The present patient group is a part of The Lund Longitudinal Dementia Study, which is an interdisciplinary project involving large groups of patients with different kind of organic dementia. Early and correct diagnosis is of great importance. The present paper has shown that rCBF measurements are an important tool in diagnosing frontal lobe dementia, paralleled with clinical investigation. The case report shows both the rCBF aspect, the typical features of Pick's Disease, as well as a clarifying neuropathological outcome. This case report also shows the typical behaviour seen in patients with lesions in the prefrontal regions, as mentioned earlier, with the inability to compare the plan of an action with the outcome actually obtained. Further, the case report, as well as other not mentioned examples from the present medical journals; clearly show the lack of critical evaluation seen in patients with this frontal area damage.

18 patients had a clear subnormal blood flow level, 2 patients were noticed in the high average, and 6 patients in the low average as in normal zone while the remaining patients had a normal blood flow level. These findings indicate damage in the measured areas, which are helpful assets in distinguishing the different types of dementia.

The results show an overweight of patients with bilaterally blood flow changes particularly in the frontal and fronto-temporal areas, but also that asymmetrically atrophy does occur. Still one has to consider that the patients' rCBF-level has been measured in different decades, perhaps providing different results due to less and more developed rCBF-instruments.

The present patient group is a special group in that way that the patients have been thoroughly clinically, psychologically and neurophysiologic ally investigated, as well as the autopsies. To fully appreciate this material one has to make a platform of basic knowledge about the patients and the investigations they have underwent. This paper concentrates on this purpose, making a picture of rCBF measurements in frontal lobe dementia patients, which explains the absence of statistical analysis. This is rather an important platform for further research with these patients, as well as an important part in thread with the Longitudinal Dementia Study. A next research project (a D-uppsats maybe?) could be to investigate the correlation between diagnosis made with rCBF measurements and autopsies. A previous study (Risberg 1985)

showed about a 90% agreement between diagnosis by rCBF and diagnosis at autopsy. Does this match with the present patients? To be able to answer this question, one has to be aware of the patient's rCBF measurement results, as have been shown prior.

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