

A Case of Late-Onset Psychosis: Integrating Neuropsychological and SPECT Data

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ABSTRACT

We report the case of a 67-year-old woman who experienced a sudden onset of psychotic illness (i.e., prominent delusions and hallucinations) that has endured for approximately 3 years. As part of her neurobehavioral work-up, a SPECT scan revealed right frontal and left anterior temporal-lobe hypoperfusion. Serial neuropsychological evaluations obtained 2 years apart demonstrated a steady decline on tests of executive control (monitoring, allocation of attention, perseveration) and visuospatial abilities, whereas performance in other areas of cognitive functioning have remained steady and in the normal range for the patient's age. Over this same period of time, serial EEG, MRI, and neurology examinations have been within normal limits. Thus, there was little evidence with which to diagnose dementia. It is suggested that concomitant impairment in executive control, coupled with a degraded capacity to process perceptual information, can give rise to enduring psychotic behavior. (*J Geriatr Psychiatry Neurol* 1996; 9:146–153)

Late-onset psychoses are relatively common in individuals suffering from dementia,^{1–3} but rare when the evidence of dementia is equivocal.⁴ Previous reports of late-onset psychoses (LOP) without dementia have described a relatively homogeneous set of symptoms that include paranoid delusions, hallucinations (mostly auditory), and a chronic course.^{5–9} Intellect and personality have been described to be fairly well preserved.¹⁰ Roth¹¹ hypothesized that individuals with paraphrenia, a syndrome that includes LOP, are genetically predisposed to schizophrenia, but that environmental stressors do not elicit the psychotic behavior until later in life.

The neuropsychiatric literature has associated delusional behavior with lesions involving the right hemisphere,^{12–15} the frontal lobes,^{16–19} the basal ganglia,^{20,21} and

the temporal lobes.^{3,22} Few studies have investigated LOP with functional imaging techniques such as PET or SPECT.^{5,23} In one study, Miller and associates²³ found that 83% of patients with LOP have at least one area of hypoperfusion in either the frontal or temporal lobes.

To our knowledge, no studies have combined SPECT and serial neuropsychological evaluations to gain a broader understanding of LOP. In this paper, we describe an elderly woman suffering from LOP. Over a 2-year period, serial MRI and neuropsychological assessments were obtained. A SPECT scan was obtained 3 years after the onset of her illness.

CASE REPORT

C.K. is a 67-year-old, right-handed woman with 10 years of education, who first presented with a psychotic disorder in January 1992. That January, she was alone in her house for an extended period of time while her husband was hospitalized. Apparently, there was an attempted break-in while she was alone in the house, but the would-be burglars were scared off. C.K. called the police, and she was found cowering next to her bed with a gun in her hand. Since that time, she has reported that there are “people” living in her closets, attic, and basement. C.K.’s description of these phantom boarders included a detailed description of their physical characteristics. She reported “hearing and smelling them” and

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that “they eat my food.” When asked if she truly believed people were in her house, CK replied, “I’m not manufacturing this in my mind . . . I’m not mentally ill, but my mother had paranoid schizophrenia.” When asked why her husband was not bothered by these intruders, C.K. answered, “No one else hears them because they are quiet when my husband and others are around.” After the onset of her psychotic illness the police were again called to C.K.’s house because she had fired a semi-automatic weapon into her yard. When queried about this incident, C.K. said that she was shooting at the boarders “to scare them off.”

The patient’s daughter and husband described C.K.’s premorbid personality as including long-standing suspiciousness, but actual paranoia was denied. When queried on DSM-IV criteria of paranoid, schizoid, and schizotypal personality disorders, as well as schizophrenia and major depression, the patient’s family denied nearly all symptoms. C.K.’s suspiciousness centered on strangers (i.e., she was always fearful of strangers approaching her children), and was very fearful of someone breaking into the house. In addition, she has always been fearful of being left alone. The patient’s daughter confirmed that C.K.’s mother had suffered from schizophrenia.

Her past medical history was significant for colon cancer (colonectomy in 1982), myocardial infarction in 1980, hypertension, and adult-onset non-insulin-dependent diabetes. C.K. was reported to have abused alcohol in her twenties and thirties, but her family denied any alcohol abuse in recent decades. She worked as a waitress, and a cashier, and was a homemaker.

Psychiatric and Neurologic Evaluations

C.K. was seen by several physicians over the 3-year course of her psychotic illness. [Henceforth, time 1 refers to evaluations performed during 1992 and time 2 refers to evaluations that occurred in early 1995.] At time 1, the initial psychiatric evaluation was positive for a diagnosis of either dementia or late-onset schizophrenia. The initial neurology evaluation was negative and EEG, B₁₂, folate, and thyroid studies were all normal. T₁- and T₂-weighted MRI studies found no evidence of generalized or lobular atrophy, or periventricular/deep white-matter alterations.

By time 2, C.K.’s general mobility had declined, and her gait had become unsteady with frequent falls. MRI and metabolic studies were unchanged. A second neurology evaluation revealed mild parkinsonian features, including a masked face and an occasional bilateral, upper-extremity tremor, but no focal signs were present. A SPECT scan was obtained at time 2 using a Toshiba dual-head gamma camera with 30 mCi DuPont/Merck Neurolite ^{99m}Te Bicisate tracer. The SPECT image was read as positive for right frontal and possible left temporal hypoperfusion (Figs. 1 through 3).

Neuropsychological Assessment

At time 1, C.K. appeared disheveled, slightly obese, and with poor dental hygiene. Her affect was rather flat; she demonstrated a paucity of facial expression, and there was a slight, bilateral, upper extremity tremor. Her speech was clear, coherent, and without word finding problems. Neuropsychological results are reported in Table 1.

Age-equivalent norms were utilized. Where norms did not exist, we converted raw scores to Z scores based on a sample of 10 age- (mean = 68.0, SD = 7.5) and education- (mean = 11.1, SD = 2.1) matched normals seen in our laboratory as part of other ongoing research projects. Scores obtained from global measures of cognition and depression, such as the Mini-Mental State Examination (MMSE)²⁴ and the Geriatric Depression Scale (GDS)²⁵ were normal. Performance on the Similarities subtest from the Wechsler Adult Intelligence Scale–Revised (WAIS-R),²⁶ the 9-word California Verbal Learning Test (CVLT),²⁷ the Boston Naming Test (BNT),²⁸ and subtests from the Boston Diagnostic Aphasia Examination (BDAAE),²⁹ which assessed auditory comprehension, repetition, and reading, were all normal considering the patient’s age and education.

By contrast, C.K. demonstrated significant deficits on tests of executive control and visuospatial ability. While her score on the Wechsler Memory Scale–Revised (WMS-R)³⁰ Mental Control subtest was only mildly impaired, on the Trail Making Test–Part B,³¹ time to completion was greater than 3 standard deviations below the mean, and 8 errors were made. Output on tests of phonemic word-list generation (e.g., letters ‘FAS’)³² was 2.37 standard deviations below the mean.

Her performance on visuospatial tests was variable. C.K. was able to match three of the four figures from the WMS–Visual Reproduction subtest.³³ Clock drawings with hands set for “ten after eleven” to command and copy³⁴ were basically normal. On the WAIS-R Block Design subtest, C.K.’s overall test score was in the low average range, which was consistent with her general level of intellectual functioning. However, when C.K.’s responses were mapped out using a flow chart,³⁵ it could be seen that her designs were constructed using a rather segmented, feature-by-feature response style. Copy of the figures from the WMS–Visual Reproduction subtest³³ were also quite segmented.

At time 2, C.K. was seen by our service because her psychotic illness had not improved and her motility had declined. During the previous 2 years, C.K.’s psychiatric symptoms had been treated with a variety of medications including carbamazepine, thiothixene, and paroxetine, to no avail. She continued to describe the same delusional phenomena reported 2 years earlier. Overall, most of C.K.’s test scores experienced only a modest decline (Table 1). For example, her performance on the MMSE was only marginally different from time 1, performance on the CVLT was unchanged compared to

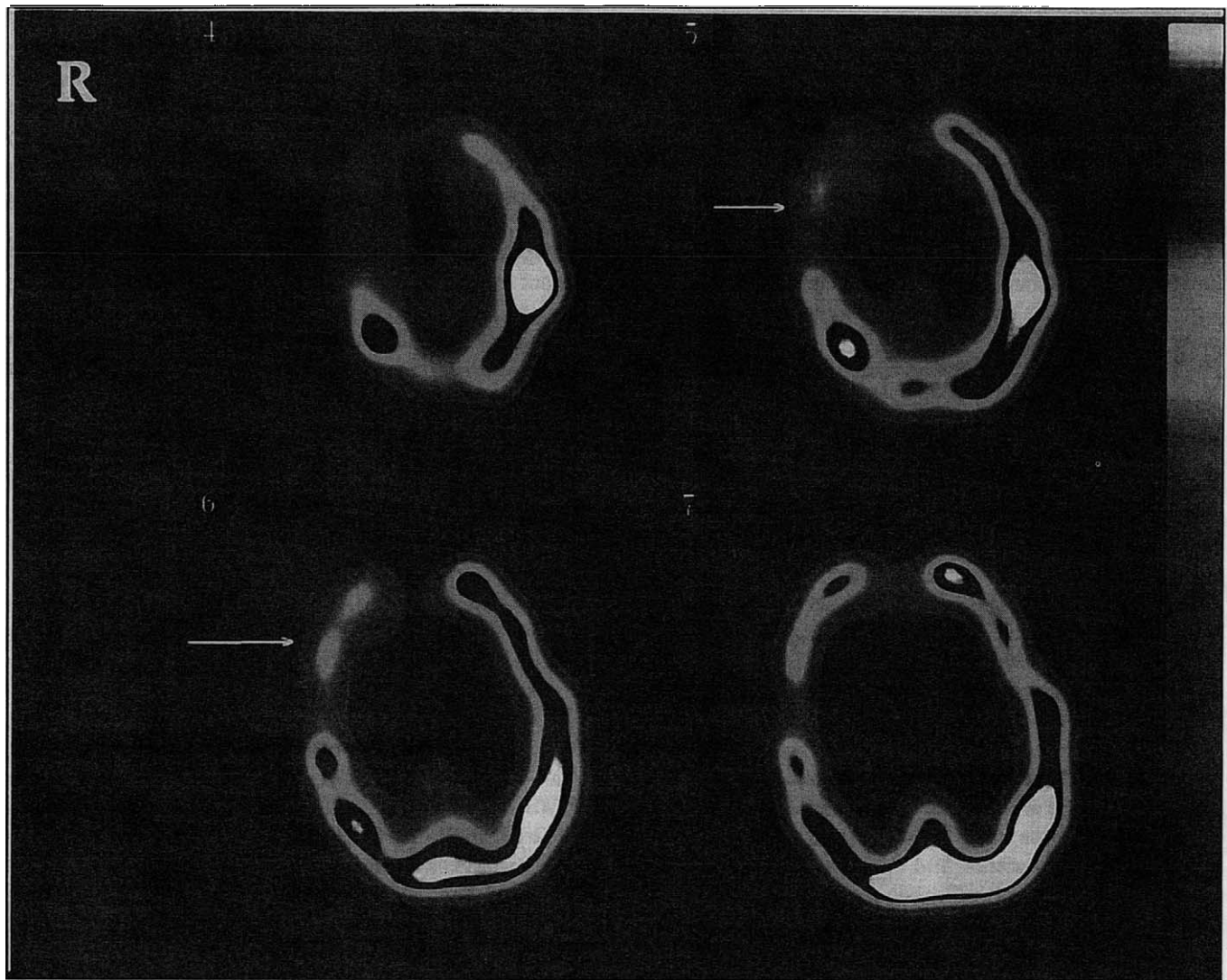


Figure 1. Axial section of a SPECT study of the brain demonstrating right frontal lobe hypoperfusion (arrow).

1992, and her scores on tests of language and general intellectual functioning declined relatively little from time 1 to time 2 (e.g., WAIS-R subtests information: 37th percentile; comprehension: 16th percentile; similarities: 16th percentile) continued to be in the low average range.

There was significant decline from time 1 to time 2 on tests of executive control and visuospatial functioning. On the WMS-Mental Control subtest, time to completion was slower and C.K. required greater effort to complete the test. Whereas her performance on the Trail Making Test-Part B was significantly impaired 2 years earlier, C.K. was now totally unable to establish set on this test. Although not tested at time 1, C.K. made an extraordinary number of perseverations (i.e., 66) on the Graphical Sequences Test^{36,37} compared to an average of 1.17 and 7.18 perseverations made by age-matched elderly control subjects and subjects diagnosed with Alzheimer's disease and ischemic vascular dementia, respectively. Finally, C.K. was also unable to establish

set on either the standard or the modified dementia versions of the Wisconsin Card Sort Test.^{38,39}

Visuospatial skills were tested in much greater detail at time 2. C.K. was able to pass a visual-acuity screening test that is part of the Visual Object and Space Perception Battery (VOSP),⁴⁰ and she displayed no difficulty on the comparatively simple visuospatial test from this battery. C.K.'s performance on more complex visuospatial tests declined. She was only able to match two of the four figures from the WMS-Visual Reproduction subtest. Her clock drawings deteriorated to the point where various numbers were now grossly in the wrong location. C.K. continued to use a very detail-oriented response strategy on the WAIS-R Block Design subtest, and her copy of the WMS-Visual Reproduction subtest figures were now extremely segmented with many perseverations.

C.K. experienced particular difficulty on visuospatial tests requiring her to match stimuli such as faces

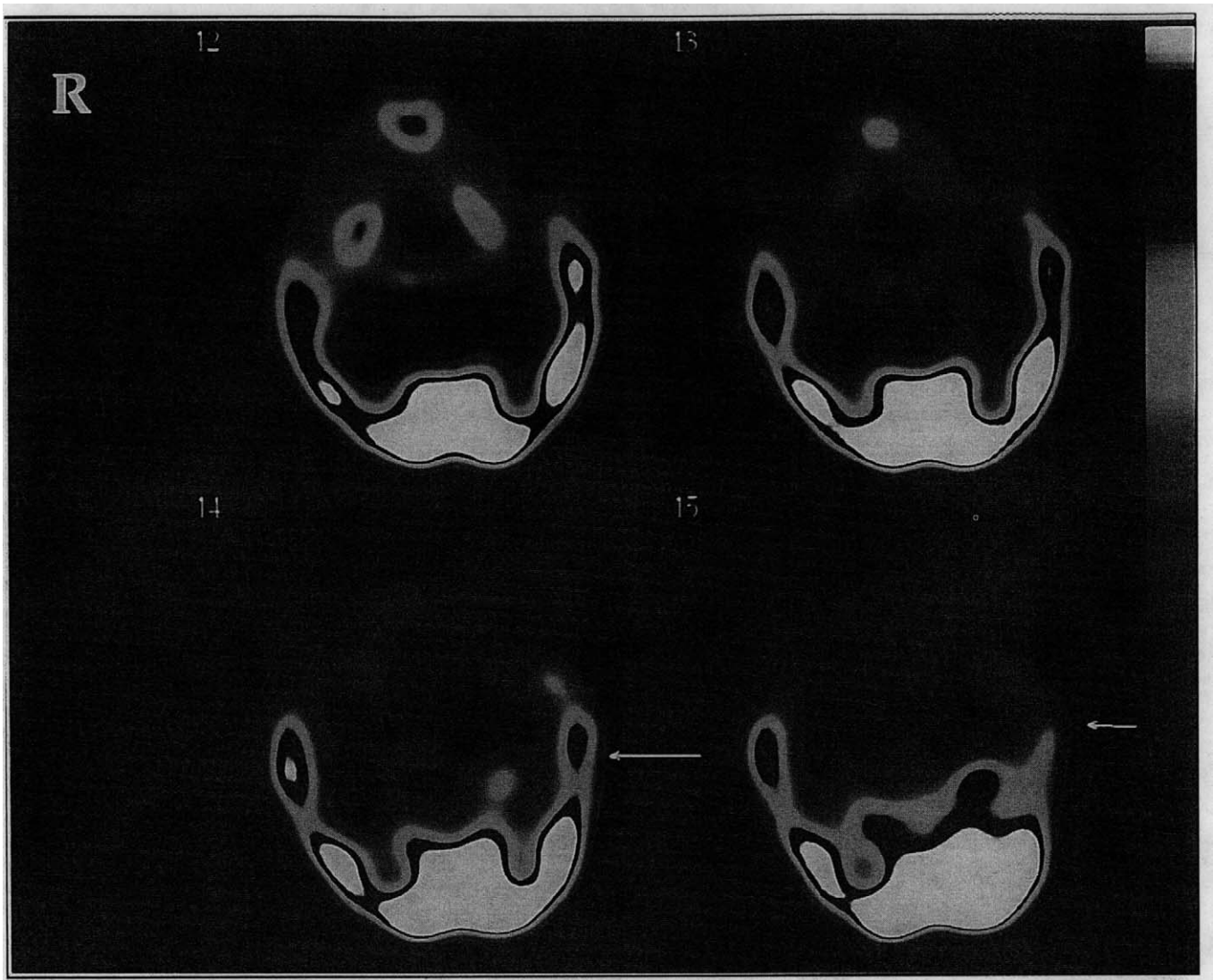


Figure 2. Axial section of a SPECT study of the brain demonstrating left temporal lobe hypoperfusion (arrow).

(Benton Facial Recognition⁴¹) and geometric designs (Benton Form Discrimination⁴²) from multiple choice arrays. On the Benton Embedded Figures Test,⁴³ her performance was severely impaired. Even greater impairment was noted on tests requiring C.K. to identify stimuli that were either ambiguous or degraded. For example, on the Hooper Visual Organization Test⁴⁴ many isolated responses were noted³⁵ (i.e., she tended to base her response on a single detail or feature contained in the stimulus). Extreme impairment was noted on the VOSP–Incomplete Letter subtest, which required her to identify partially formed letters. C.K. exhibited profound deficits on tests requiring her to identify common objects displayed in atypical or unusual views. For example, on the Unusual Views Test⁴⁵ (Table 2), when shown a picture of a lawn mower viewed from the handle, she responded “it’s a tent and a grill . . . it’s an oven and a women and a child sitting there, and two pans hanging down”.

Finally, similar distortions were noted on a task requiring C.K. to identify common household and environmental sounds, such as a vacuum cleaner, a telephone, and an automobile, heard from an audio tape. When asked to identify the sound of *chewing* she responded, “it’s someone mopping the floor” (Table 2).

DISCUSSION

From a diagnostic point of view, C.K. appears to meet criteria for late-life onset schizophrenia. Although cognitive deficits were present in both neuropsychological evaluations, C.K.’s performance on tests of memory, language, and general intellectual functioning were unchanged from time 1 to time 2; and performance on these tests was consistent with her past educational and occupational history. Thus, the pattern of cognitive deficits described above is not consistent with prodromal Alzheimer’s disease or a cerebrovascular dementing disorder. There

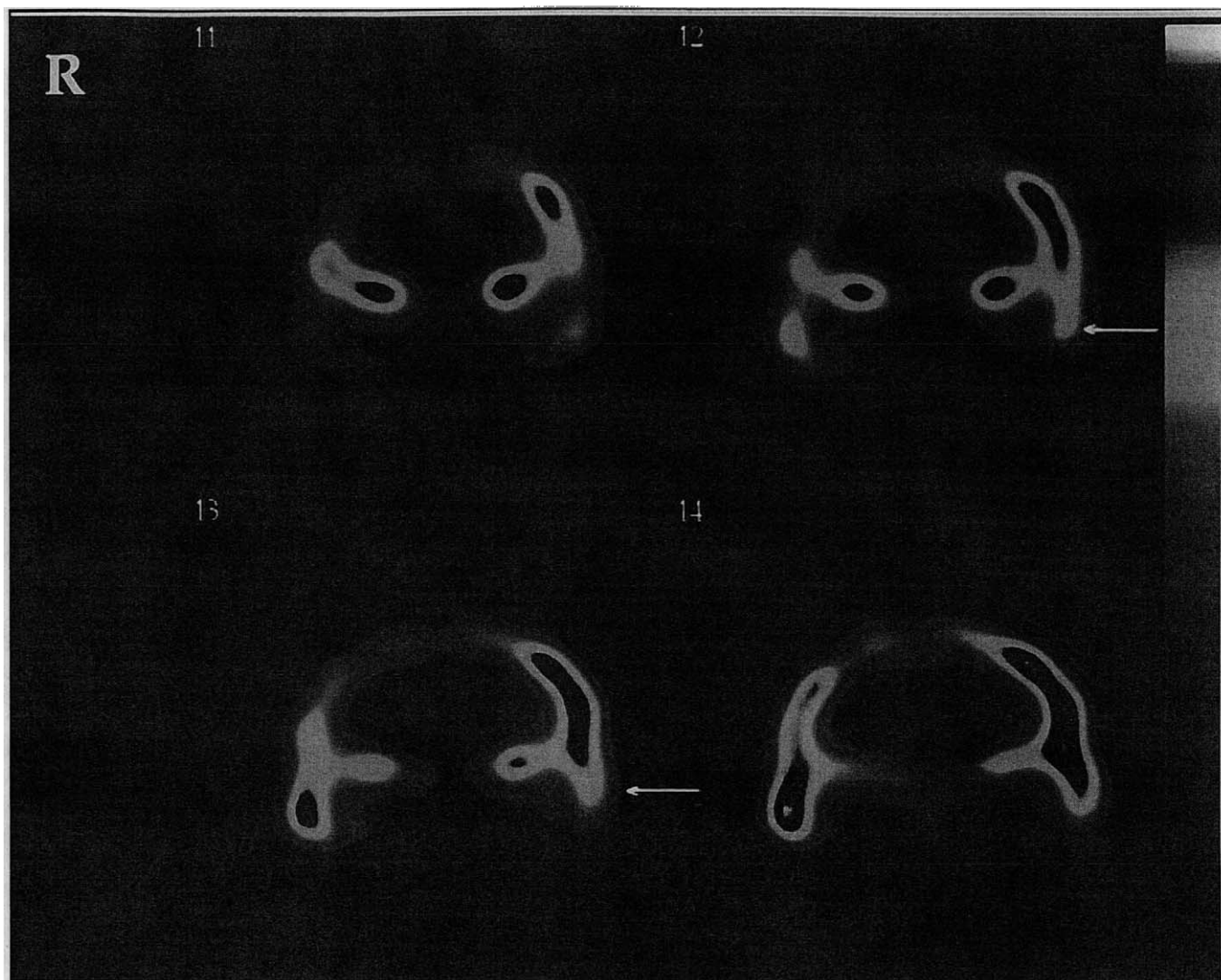


Figure 3. Coronal section of a SPECT study of the brain demonstrating left temporal lobe hypoperfusion (arrow).

are, however, some other diagnostic possibilities. For example, there are similarities between C.K.'s clinical presentation and characteristics of senile dementia of the Lewy body type (SDLB). McKeith and colleagues⁴⁶ have shown that in life, patients with autopsy-verified SDLT often suffer from psychotic symptoms including vivid hallucinations, mild extrapyramidal symptoms, and reduced motility with frequent falls. C.K. suffers from all of these problems. The relationship between LOP and Lewy body disease merits further study. Another diagnostic possibility is that C.K. may be suffering from frontotemporal dementia^{47,48} (FTD). As with C.K., the SPECT scans of patients with FTD invariably show frontal-lobe hypoperfusion and a past family history of major psychiatric illness is often present. Unlike with C.K., however, FTD is often associated with early alterations in expressive language, little to no impairment on visuospatial tests, and changes in personality involving disinhibition and irritability. Also, we are not aware of any prior clinical

reports of FTD that present with such a striking acute-onset of psychotic symptoms as seen in our patient. Therefore, we do not believe that a diagnosis of FTD is appropriate at the present time.

C.K.'s very piecemeal, feature-by-feature response style on the WAIS-R Block Design subtest, and her performance on other visuospatial tests suggests that she has difficulty in processing visuospatial information as gestalts. This type of response style is often seen in patients with known right-hemisphere, particularly right frontal-lobe, pathology.³⁵ We believe that most of her neuropsychological deficits are caused primarily by an impairment in frontal systems functioning, which was clearly indicated on her SPECT scan.

Some of the theoretical ideas of Conrand and Matussek (see Cutting⁴⁹) may help place C.K.'s neuropsychological deficits and delusional behavior in context. The first stage in the formation of delusions involves a perceptual derangement whereby patients fail to

Table 1. Neuropsychological Test Results

Test Score	October 1992		January 1995	
	Raw	z	Raw	z
Global Measures				
MMSE	27		25	
GDS	6		8	
Motor Functioning				
Finger Oscillation Test (right hand)	NA*		38.5	-0.2
Finger Oscillation Test (left hand)	NA		25.3	-2.1
Language				
Boston Naming Test (60-item version)	57	0.2	50	-0.7
Semantic WLG (animals)	12	-1.4	10	-1.9
BDAE: Complex Ideation (no. correct)	12	99%ile	11	90%ile
BDAE: Sentence Reading Subtest (no. correct)	10	95%ile	9	86%ile
Apraxia examination	WNL		WNL	
Memory and Learning				
CVLT: list A trials 1 – 5 (maximum = 45)	35	-0.6	34	-0.8
CVLT: Delayed free recall (maximum = 9)	7	-0.5	7	-0.5
CVLT – Recognition Discriminability	93%	1.5	100%	1.0
WMS: R Logical Memory Test I	26	0.6	24	0.5
WMS: R Logical Memory Test II	23	0.7	14.5	-0.1
Executive Functions				
WMS: R Mental Control	4	-0.7	4	-0.7
TMT: Part B	192"	-1.3	discontinued	
Phonemic WLG (FAS)	12	-2.3	11	-2.4
WCST	NA		discontinued	
GST (no. of errors)	NA		66	-55.0
Visuoconstructional Tests				
Clock Drawing: command (maximum = 10)	8	-0.6	8	-0.6
Clock Drawing: copy (maximum = 10)	8	-0.6	8	-0.6
WAIS-R: Block design test (peer scale score)	7	-1.0	6	-1.3
WMS: Visual reproduction copy	6	-3.7	3.0	-5.4
Visuospatial Tests				
Benton: Facial Recognition Test (no. correct)	NA		40.0	-1.1
Benton: Visual Form Discrimination (no. correct)	NA		12.0	-2.0
Benton: Embedded Figures Test (no. correct)	NA		2.0	-15.6
Warrington and James Unusual Views Test (maximum = 20)	NA		4.0	-2.5

NA = not administered; MMSE = Mini-Mental State Examination; GDS = Geriatric Depression Scale; WLG = Word List Generation; BDAE = Boston Diagnostic Aphasia Examination; CVLT = California Verbal Learning Test; WMS-R = Wechsler Memory Scale – Revised; TMT = Trail Making Test – Part B; WCST = Wisconsin Card Sort Test; GST = Graphical Sequence Test; WAIS-R = Wechsler Adult Intelligence Scale – Revised; WMS = Wechsler Memory Scale.

understand how sensory and perceptual information are related to common everyday experience. Thus, the deluded patient views his or her surroundings as a series

Table 2. Perceptual Errors Made on Visual and Auditory Tests

Stimulus	Response
Hooper Visual Organization Test (C.K.'s raw score = 17.5, z = -1.4)	
cane	shelf
candle	cigarette lighter
key	moon
Warrington Unusual Views Test	
fan	a tire and a hanger
violin	a nut
suitcase	a cooking pan
binoculars	a telephone
lawn mower	a tent and a grill and an oven ... and a woman and a child sitting there, and two pans hanging down
Environmental Sounds Identification	
chewing	mopping the floor
alarm clock	going up the stairs
cutting with scissors	dialing the telephone
playground noises	kids talking to their mother
train	birds

of seemingly disconnected details without the ability to integrate these details into coherent wholes or gestalts. This notion is consistent with C.K.'s extreme difficulty on visuospatial and auditory tests requiring her to disembed figure-ground relationships, attach meaning to ambiguous stimuli, or identify objects placed in some unusual orientation. The second stage in the formation of delusions revolves around the attempt of the deluded patient to connect or attach some meaning to his or her perceptual distortions. Because the deluded patient is primarily dealing with fragments or details from his or her perceptual milieu, the way these perceptual fragments are linked is often bizarre. These theoretical ideas are consistent with other research findings associating deficits in prefrontal functioning with the failure of deluded patients to be self-critical and carry out the necessary reality testing to correctly interpret their surroundings.^{19,50–54}

We suggest that this reality-monitoring deficit⁵⁵ may cause a misidentified event and its associated affective state to be replayed over and over in the deluded patient's mind. The misidentified event may then become part of one's long-term memory store. C.K.'s delusions, therefore, may represent long-term memory traces of initially misperceived events.

We acknowledge that combined perceptual- and frontal-system cognitive deficits may be found in a wide variety of neurobehavioral disorders where psychosis is absent. Thus, it is not our intention to argue that combined perceptual/frontal-system cognitive deficits are either pathognomonic or the specific etiologic mechanism of all psychotic behavior. Nonetheless, we believe that deficits in frontal system functioning may be contributing to C.K.'s erroneous interpretation of sensory and perceptual information, and may be causing her to

impulsively attribute the wrong meaning to ambiguous sensory information. In this context, C.K.'s combined perceptual/frontal-system cognitive deficits may provide a heuristic mechanism to explain her delusions as well as her bizarre responses on the perceptual tests described above.

Finally, as noted above, Roth¹¹ has suggested that patients with paraphrenia or LOP may be genetically predisposed to schizophrenia, but that psychotic behaviors do not emerge until the patient experiences an inordinate amount of stress. At the onset of her illness, C.K. had been alone for an extended period of time. Suspiciousness, fear of strangers, and fear of burglary were described by C.K.'s family as part of her premorbid personality. This information, along with fact that C.K.'s mother suffered from schizophrenia, supports the notion that there may be a constitutional basis for LOP.

In sum, C.K.'s delusions may be caused by a breakdown in two separate but highly related cognitive processes. First, her capacity to integrate perceptual information into coherent wholes is impaired.⁴⁷ This breakdown necessarily involves either frank frontal-lobe lesions and/or a disruption between the frontal lobes and their reciprocal connections to other parts of the brain.⁵⁶ Second, C.K.'s failure to recognize and critically evaluate her perceptual distortions may cause the misperceived event to then become part of her long-term memory store.⁵⁷ Thus, while her memory, per se, may not be impaired, C.K.'s delusions could be propagated by her impaired frontal system's capacity to judge the plausibility and veracity of the events in question.

Additional case descriptions of patients suffering from LOP combining neuropsychological and functional imaging data may further our understanding of this puzzling but very interesting disorder.

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