The Paramedian Diencephalic Syndrome: A Dynamic Phenomenon

Irene Meissner, Shimon Sapir, Emre Kokmen, and Steven D. Stein

The paramedian diencephalic syndrome is characterized by a clinical triad: hypersomnolent apathy, amnesic syndrome, and impaired vertical gaze. We studied 4 cases with computed tomography evidence of bilateral diencephalic infarctions. Each case began abruptly with hypersomnolent apathy followed by fluctuations from appropriate affect, full orientation, and alertness to labile mood, confabulation, and apathy. Speech varied from hypophonia to normal; handwriting varied from legible script to gross scrawl. Psychological testing revealed poor learning and recall, with low performance scores. In 3 patients the predominant abnormality was in downward gaze. (Stroke 1987;18:380-385)

The paramedian diencephalic syndrome is characterized by hypersomnolent apathy, an amnesic syndrome, and abnormal vertical gaze. Synonyms, based on the presumed vasculature involved, include the syndrome of the thalamoperforating pedicle of Foix and Hillemand,1 the syndrome of the basilar communicating artery of Percheron,2 the syndrome of the mesencephalic artery,3,4 the thalamomesopontine infarction syndrome.

Attempts have been made to correlate the clinico-pathologic features with the thalamic arterial supply,1-8 and computed tomography (CT) has been used to localize the lesions.9-12

Subjects and Methods

We reviewed 4 consecutive cases seen between April and December 1983. They were all men, with a mean age of 53 years and a mean follow-up of 10 months (range, 6-18 months). CT was performed in all 4 patients and angiography in 2. A representative case is reviewed. Table 1 summarizes all 4 cases. Speech and language assessments are outlined in Table 2.

Case Report

A 52-year-old left-handed attorney suddenly collapsed, unresponsive, 3 weeks after coronary artery bypass surgery. There was semipurposeful withdrawal, a right Babinski sign, midposition and sluggish pupils, and diminished caloric responses. Vertical oculocephalic maneuvers elicited upward-gaze movement only, with a slow return to midposition. Optokinetic nystagmus was absent. Electrocardiograms implied a recent myocardial infarction, and echocardiography indicated a left ventricular aneurysm with a pedunculated apical thrombus; treatment with warfarin was instituted. CT was normal on admission but 10 days later showed bilateral areas of enhancement in the paramedian thalamic and rostral mesencephalic regions consistent with postinfarction hyperemia (Figure 1). The depressed level of consciousness and inappropriate behavior fluctuated.

Results of routine laboratory tests and analysis of cerebrospinal fluid were normal. An electroencephalogram when the patient was awake demonstrated mild dysrhythmia. Methylphenidate therapy had no effect.

Speech fluctuated from hypophonia, hypokinetic-like articulation (decreased range of articulatory motions, accelerated articulation) and aprosodia, to hoarse and slow articulation, to clear voice and intelligible speech. Occasionally there was hypernasality. Speech diadochokinetic rates were inconsistently fast, slow, or normal. Language tests revealed confabulation, perseveration, poor comprehension, right-left confusion, and disorientation. Repetition and naming were relatively spared. Reading, tested at a distance because of convergence insufficiency, was relatively intact. Attempted writing was accompanied or preceded by peculiar perseverative and confabulatory gestures (Figure 2).

Several months later there was persistent somnolence, fluctuating attention, amnesic syndrome, hypokinetic dysarthria, and impaired downgaze. Wechsler Adult Intelligence Scale psychometric testing, limited by poor concentration and easy distractability, showed a verbal IQ of 79 (within the dull-normal range) and a low memory quotient of 60. Poor attention span made it impossible to score the performance IQ.

Discussion

Many reported cases of the paramedian thalamic syndrome have lacked elements of the specific clinical triad. Castaigne et al13 reviewed 5 cases of pathologically proven paramedian thalamic infarcts. The clinical triad was seen in only 1 case. Halmagyi et al4 emphasized abnormalities of vertical gaze in 4 patients with CT evidence of bilateral thalamomesopontine lesions. Segarra1 discussed fluctuating mentation in 1 case with autopsy-proven bilateral paramedian thalamic...
Table 1. Summary of Cases

<table>
<thead>
<tr>
<th>Case 1</th>
<th>Case 2</th>
<th>Case 3</th>
<th>Case 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age/sex/handedness</strong></td>
<td><strong>Stroke risk factors</strong></td>
<td><strong>Clinical onset</strong></td>
<td><strong>CT head scan:</strong></td>
</tr>
<tr>
<td>52/male/left</td>
<td>None known</td>
<td>Sudden disorientation and hypersomnolence</td>
<td>Admission</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Negative</td>
</tr>
<tr>
<td><strong>Follow-up</strong></td>
<td><strong>CT head scan:</strong></td>
<td><strong>Clinical onset</strong></td>
<td><strong>CT head scan:</strong></td>
</tr>
<tr>
<td></td>
<td>Day 2: bilateral paramedian thalamic infarcts (L &gt; R); extension L internal capsule</td>
<td>Sudden LOC</td>
<td>Day 2: bilateral paramedian thalamic infarcts</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cerebral arteriogram</strong></td>
<td><strong>Impaired downgaze</strong></td>
<td><strong>Clinical onset</strong></td>
<td><strong>Follow-up</strong></td>
</tr>
<tr>
<td>Not done</td>
<td>+</td>
<td>Sudden LOC</td>
<td>Day 2: bilateral paramedian thalamic infarcts; extension rostral mesencephalon</td>
</tr>
</tbody>
</table>

The course of all 4 patients included fluctuating hypersomnolence. The status at follow-up for all 4 patients included fluctuating attention span, fluctuating hypokinetic-like dysarthria, amnesic syndrome, and downgaze paresis.

CT, computed tomography; LOC, loss of consciousness; L, left; R, right; +, present; -, absent. *Case 4 also showed left 6th nerve palsy.

ic infarcts. Abnormalities of vertical gaze were observed, but lethargy precluded assessment of memory.

All 4 of our patients had similar clinical features: apoplexy at presentation, fluctuating hypersomnolence, speech abnormalities, and amnesic syndrome all persisting for months. In 3 patients, impaired vertical gaze improved or resolved.

CT showed bilateral diencephalic infarcts in all 4. One patient (Case 4) differed from the others because he had subarachnoid and intraventricular hemorrhage. The diencephalic infarcts may have resulted from operation for an aneurysm of the posterior communicating artery. Embolism was presumed in the first patient, with a documented cardiac embolic source, and perioperative ischemia in Case 4. No identifiable mechanism was found in the other 2. Neuropathologic documentation of the paramedian thalamic syndrome is limited.10-13,15-18 Poirier et al15 presented a case of thalamic dementia without abnormalities of ocular motility. Autopsy 5 years after symptom onset revealed lacunae or perivascular cystic cavitations with a segmental necrotizing angiitis in the territory of the thalamoperforating pedicle.

Thalamic blood supply is complex and variable (Figure 3), explaining why paramedian thalamic infarctions are usually accompanied by more extensive infarcts in the thalamus and midbrain. Thalamoperforating branches of the posterior communicating and proximal posterior cerebral arteries supply the medial thalamic region. These branches may arise separately from the proximal posterior cerebral arteries (Figure 4, Type I). Alternatively, the vessels may originate from a single trunk leaving the proximal posterior cerebral artery or the basilar caput (Figure 4, Type II); this pattern accounts for bilateral paramedian thalamic infarcts with a single vascular occlusion. Sometimes an arterial arcade joins bilateral thalamoperforators (Figure 4, Type III).2,13

The paramedian thalamic syndrome includes an amnesic syndrome similar to the Korsakoff syndrome,19 in which memory is deranged out of proportion to the alteration in other components of mentation and behavior; both anterograde and retrograde amnesia are present. Victor19 suggested that damage to the medial dorsal nucleus of the thalamus, rather than the mamilary bodies, produces the amnesic syndrome.

Other features of the paramedian thalamic syndrome include a "subcortical" form of dementia with preservation of verbal IQ and relative absence of aphasia, agnosia, or verbal apraxia. The disorder is manifested primarily by lack of spontaneity, slowness of thought, confabulation, and poor insight.19-24

Table 2. Speech and Psychometric Evaluation

<table>
<thead>
<tr>
<th>Case</th>
<th>VIQ</th>
<th>PIQ</th>
<th>MQ</th>
<th>WAIS</th>
<th>Auditory comprehension</th>
<th>Repetition</th>
<th>Naming</th>
<th>Reading*</th>
<th>Writing*</th>
<th>Speech (volume, articulation, and rate)</th>
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<tbody>
<tr>
<td>1</td>
<td>79</td>
<td>—</td>
<td>60</td>
<td>Poor</td>
<td>+</td>
<td>+</td>
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<td>+/−</td>
<td>+/−</td>
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<tr>
<td>2</td>
<td>72</td>
<td>77</td>
<td>57</td>
<td>Poor</td>
<td>+</td>
<td>+</td>
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<td>—</td>
<td>59</td>
<td>Fair</td>
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<tr>
<td>4</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>Poor</td>
<td>+</td>
<td>+</td>
<td>Poor</td>
<td>—</td>
<td>+/−</td>
<td>+/−</td>
</tr>
</tbody>
</table>

VIQ, verbal IQ; PIQ, performance IQ; MQ, memory quotient; WAIS, Wechsler Adult Intelligence Scale; —, unable to test due to poor attention span; +, normal; +/−, fluctuating from normal to grossly deficient.

*Perseveration and confabulation of speech and writing (see text).
FIGURE 1. Case 1. Enhanced computed tomography (CT) scan of the head, performed 10 days after ictus, demonstrates bilateral paramedian diencephalic infarctions with hyperemia. Left hemisphere is on right side of scan.

The neuroanatomic basis for the language disorder after bilateral thalamic infarction is unclear. Specific localized thalamic language syndromes have been suggested. Sparing of repetition, the hallmark of transcortical aphasia, is often seen. Alterations in the thalamocortical relay system have also been proposed. Brown suggested that there may be a bias in the thalamus that is comparable to hemispheric dominance; he found a higher incidence of "aphasia" after left thalamotomy and of dysnomia and verbal memory changes after stimulation of the left thalamus. Damage to the pulvinar has been implicated in anomia. Damage to the medial dorsal nuclei of the thalamus may play a role as well.

Behavioral abnormalities have included hypersomnolence, confabulation, perseveration, confusion, disorientation, and slow, delayed responses. Speech anomalies included hypophonia, hypokinetic-like articulation, and occasional accelerated diadochokinetic rate with decreased range of motion. These extrapyramidal elements possibly relate to loss of input to the thalamus from the basal ganglia and substantia nigra.

Language abnormalities of different levels of severity were seen in all modalities. Confabulatory and perseveratory responses, both in verbal and written forms, were the striking characteristics. Auditory comprehension for simple commands was intact, whereas comprehension of complex commands was mildly or severely impaired. Reading comprehension was difficult to assess because of convergence insufficiency. When testing was possible, there was evidence for comprehension of simple written commands and not of complex and right–left orientation commands. Short-term memory for digits and sentences was mildly or moderately impaired. Naming was intact in all patients, and oral spelling was moderately impaired in 2 of the patients. The patients’ confabulatory responses sometimes resembled psychotic speech. For example, when asked why he was in the hospital, one of the patients replied, “I have trouble with bugs. A big fly . . . that big fly . . . it frightens me . . . haven’t seen him this year. He shows up the time that my boy does.” Another patient replied to the same question with, “A building collapsed on me.” These responses were said in total apathy and indifference. Moreover, when asked the same question at different times during the language testing, the responses were either appropriate or different from the previous responses.

The amnesic, affective, and dysnomic features of specific thalamic nuclear lesions resemble cortical syndromes. However, in contrast to the more stable cortical dementias, these 4 patients all demonstrated dramatic fluctuation in symptoms, within hours or even minutes. Ojemann suggested that the destruction of specific “alerting” and attention-focusing mechanisms could disrupt stored memory retrieval processes in a fluctuating way. It is not clear why the syndrome is seen after bilateral but not unilateral lesions.

Dysorthographia, or disturbed written elements without oral language difficulty, is seldom emphasized.

FIGURE 2. Case 1. Writing sample obtained during psychometric testing. The patient was asked to write “man,” “yellow,” and “white.”
in reports of these patients. In 3 of our cases, attempted writing was accompanied or preceded by perseverative and confabulatory gestures that paralleled the language disturbance. There were variable and fluctuating degrees of legibility, ranging from normal script to illegible scrawl. Interruption of input from the reticular activating system to bilateral intralaminar thalamic nuclei has been postulated as a mechanism for the general deficit in vigilance and associated fluctuations in speech, language, and writing seen in these patients. An adequate trial of methylphenidate in 2 patients provided no sustained improvement in sensorium and performance.

Although abnormalities of upward gaze are the result of lesions involving the pretectum and posterior commissure, paralysis of downward gaze occurs specifically after more rostral discrete bilateral lesions within the diencephalic–mesencephalic junction; these include the nuclei of Darkshevich and the interstitial nuclei of Cajal of the prerubral region. The rostral interstitial nucleus of the medial longitudinal fasciculus and the retroflex fasciculus have been implicated in selective paralysis of downward gaze, although substantial human pathologic correlation is lacking. In 1 reported patient, the abnormality of vertical gaze was thought to be an apraxia related to disruption of corticofugal fibers passing through the medial thalami.

In 3 of the 4 patients reported here, the deficiency of downward gaze remained relatively constant compared with the fluctuating course of the other symptoms. The fourth patient, with a subarachnoid hemorrhage, deviated from the group by presenting primarily with a sixth-nerve palsy.

Other ocular abnormalities described and noted in our patients on admission included abnormalities of the pupillary light reflex and convergence insufficiency. Whereas the pupillary abnormalities may relate to involvement of the posterior commissure or periaqueductal gray matter, the precise location of the "convergence center" remains obscure.

**FIGURE 3.** Thalamic vasculature (by permission of the Mayo Foundation).

**FIGURE 4.** Arterial patterns of origin of paramedian thalamoperforating arteries. Type I: Branches arise separately from ipsilateral proximal posterior cerebral arteries. Type II: Branches arise from a single trunk off the proximal posterior cerebral artery or basilar caput. Type III: Arterial arcade joins bilateral thalamoperforators (modified from Castaigne et al[13]).
The paramedian diencephalic syndrome may not be as rare an entity as originally thought. The abrupt onset of hypersonolomental apathy, persistent amnesic syndrome, fluctuating sensorium, and dysfunction of downward gaze should suggest this syndrome to the clinician (Figure 5). The dynamic, inconsistent, and fluctuating temporal profile can be a clinical diagnostic aid in differentiating this syndrome from the more stable cortical and extrapyramidal disorders.

References
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KEY WORDS • amnesia • apathy • diencephalic infarction • impaired gaze • paramedian thalamic syndrome
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