

# Pathological Laughing

## Brain SPECT Findings

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**Abstract:** We present the case of a 40-year-old man consulting for uncontrollable episodes of laughing related to emotional lability and not systematically linked to feelings of happiness. Seven months earlier he had presented a pontine ischemic stroke related to an occlusion of the basilar and left vertebral arteries. No epileptic activity or new MRI brain lesions were found. Brain perfusion SPECT performed showed marked hypoperfusion in the right frontal inferior and temporoinsular regions, suggesting a diaschisis phenomenon caused by pontine lesions and highlighted laughing regulation pathways. The patient was successfully treated with a serotonergic reuptake inhibitor, fluoxetine.

**Key Words:** pathological laughing, brain perfusion imaging, brain SPECT, diaschisis

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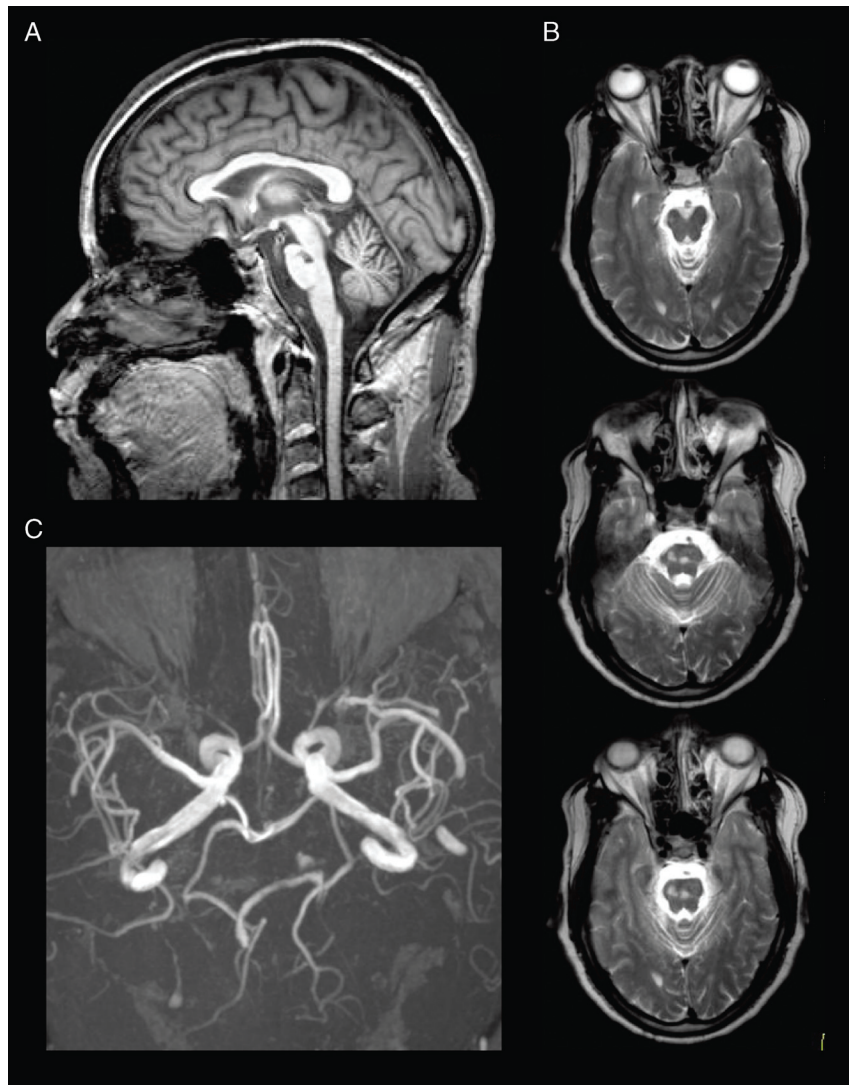
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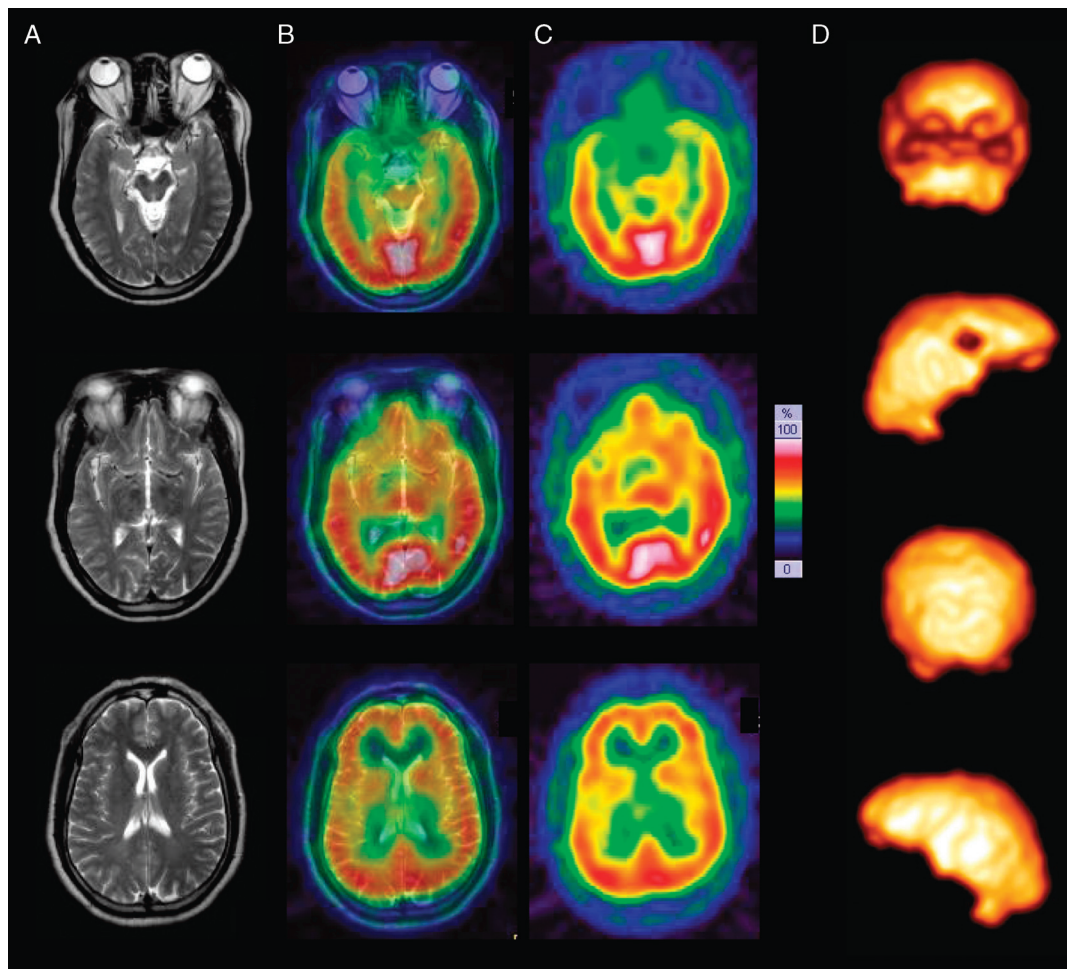
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**FIGURE 1.** A 40-year-old man with a history of hypertension, dyslipidemia, chronic rejection of renal transplant, and ischemic pontine stroke 7 months earlier. On admission at the acute stage of stroke, neurological examination showed tetraparesis, bilateral facial palsy, dysarthria, deglutition problems, and bilateral cerebellar syndrome. The patient was treated with antithrombotic treatment associating aspirin and curative anticoagulation. The clinical outcome was highly favorable at 1 month, and the patient was symptom-free for the motor and the cerebellar symptoms. Sagittal T<sub>1</sub>-weighted (A) and three successive transverse T<sub>2</sub>-weighted MRIs (B) show ischemic lesions of the upper pons related to an occlusion of the basilar and left vertebral arteries (C, angio-MRI, time-of-flight sequence).



**FIGURE 2.** The patient consulted for uncontrollable episodes of laughing related to an emotional lability, 7 months after the pontine stroke. During these episodes, the emotional sensations of the patient were highly variable and not systematically linked to feelings of happiness. Brain perfusion SPECT was performed in this period after intravenous injection of 740 MBq  $^{99m}\text{Tc}$ -ECD. Matched transverse slices (A, T<sub>2</sub>-weighted MRI; B, fused MRI-SPECT; C, SPECT) and 3D volume rendering SPECT (D) show pronounced hypoperfusion in right inferior frontal, insular, and temporal basal-polar-intern regions as well as right basal ganglia without any new lesion on MRI, suggesting a diaschisis phenomenon resulting from pontine lesions and highlight laughing regulation pathways. The patient was successfully treated with serotonergic reuptake inhibitor (fluoxetine 5 mg/day). The first case of pathological laughter was described in 1903 by Féré.<sup>1</sup> This syndrome is most often related to a stroke in the vertebrobasilar territory.<sup>2,3</sup> Patients with the most severe symptoms are those with bilateral pontine lesions.<sup>4</sup> However, neural pathways involved in pathological laughter are not yet fully known and remain a matter of controversy.<sup>5,6</sup> It has been hypothesized that pathological laughter was caused by a loss of regulation of a presumed “center for laughter” located in the brainstem connected to the facial and vagal nerve nucleus. Laughter seems to depend on 2 neuronal pathways: a voluntary system originating in the frontal cortex and an emotionally driven system receiving inputs from disparate regions of the brain (hypothalamus, orbitofrontal cortex, basal temporal cortex, basal ganglia, and thalamus).<sup>7</sup> Interestingly, temporal poles have already been implicated in cases of gelastic epilepsy.<sup>8</sup> The pons and cerebellum could modulate emotional responses.<sup>9</sup> Hypoperfused areas demonstrated in this case are likely to be caused by a diaschisis phenomenon resulting from a pontine lesion because no corresponding abnormalities are seen on MRI. The neural pathways highlighted fit the laughter model described above. Pontine infarction could also damage raphe nuclei from the area where serotonergic projections emerge. This hypothesis could explain the recovery from pathological laughing with a serotonergic reuptake inhibitor, confirmed in several studies.<sup>10</sup>