

Ipsilateral reversible diaphragmatic paralysis after pons stroke

Germán Morís · Mónica Arias · Jose M. Terrero ·
Carmen Izquierdo · Manuel M. Muñiz

Received: 12 August 2011 / Revised: 14 September 2011 / Accepted: 15 September 2011 / Published online: 1 October 2011
© Springer-Verlag 2011

Dear Sirs,

Neurological disease may present with respiratory dysfunction. This presentation is also well recognized for stroke although the precise mechanisms responsible for respiratory problems are poorly understood. Diagnosis of respiratory dysfunction resulting from diaphragmatic paresis after stroke has been reported but few data are available about the effects of stroke on the diaphragmatic function. It is commonly thought that respiratory muscles are under bilateral hemispheric control although diaphragmatic excursion reduction and cases of diaphragmatic paralysis on the hemiplegic side have been reported in stroke patients [1, 2]. We report a case of a patient with unilateral diaphragmatic palsy contralateral to the hemiparetic side.

A 65-year-old woman awoke with vomiting, dizziness and left hemiparesis. There was no history of recent trauma of the neck or the chest or recent surgery. On admission, her pulse rate was 80 beats/min, blood pressure was

110/60 mm Hg, and respirations were 15/min and regular. The patient denied dyspnea. The neurological examination showed a normal mental status. Her speech was dysarthric. The visual fields were intact; pupils were equal, with a normal light reflex; and ocular movements were full and smooth, without nystagmus. A mild left hemiparesis was present involving the face. There were no sensory deficits to touch, pain, temperature, vibration, or position sense. There was no ataxia on either side. No abnormality was demonstrated on brain computed tomography performed in the acute stage. Extensive laboratory investigations including hematological and biochemical parameters were unremarkable. Electrocardiogram, echocardiogram and carotid Doppler studies were normal. Chest radiograph revealed an elevated right hemidiaphragm (Fig. 1a). The brain magnetic resonance imaging (MRI) showed an area of increased signal intensity on T2 weighted or FLAIR images involving the paramedian region of the right pons (Fig. 2). The lesion showed focal restricted diffusion by using MRI diffusion-weighted imaging. The disturbance of neurological symptoms gradually improved. Complete resolution of diaphragmatic elevation and no hemiparesis were detected on day 60 of follow-up (Fig. 1b).

The diaphragm is considered to contribute up to 60–70% of the total ventilation at rest, in both sitting and supine positions. Hemidiaphragmatic paralysis results in a vital capacity decrement of 10–30%, with the most substantial decrements seen in the supine position [3]. Breathing can be activated either automatically or volitionally [4]. The exactly cortical motor representation of respiratory muscles is not completely understood and there is no clear evidence of cerebral dominance for diaphragm function [5]. The descending pathways of the voluntary system are associated with the corticospinal tracts in the brainstem and upper cervical cord [6].

G. Morís · M. Arias · J. M. Terrero
Neurology Service, Hospital San Agustín,
Avilés, Asturias, Spain

G. Morís (✉)
Servicio de Neurología, HUCA, C/Celestino Villamil s/n.,
33006 Oviedo, Asturias, Spain
e-mail: gmorist@gmail.com

C. Izquierdo
Radiology Service, Hospital San Agustín,
Avilés, Asturias, Spain

M. M. Muñiz
Respiratory Service, Hospital San Agustín,
Avilés, Asturias, Spain

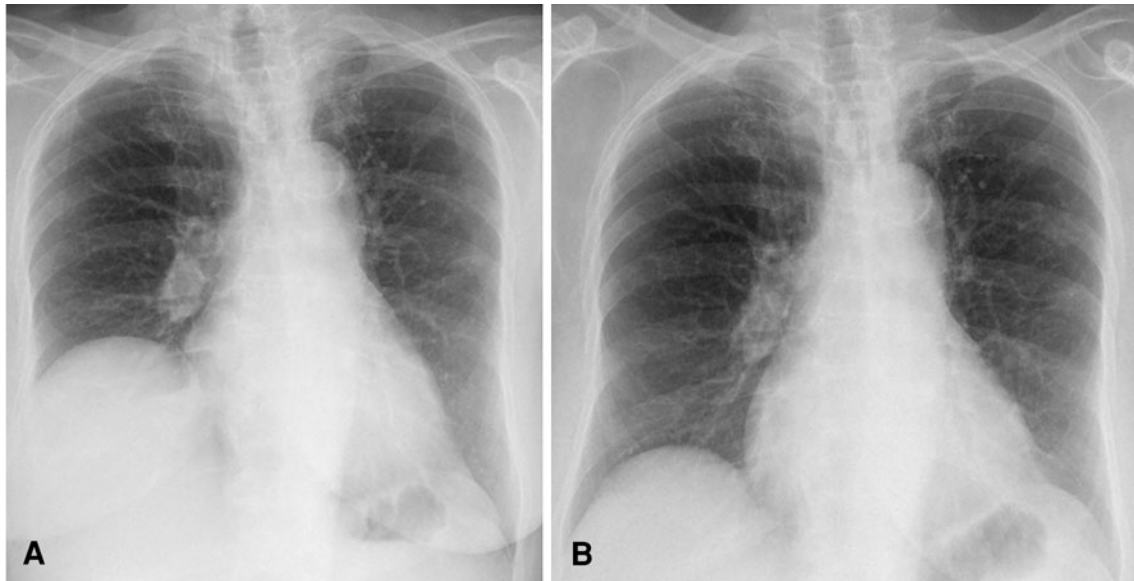


Fig. 1 **a** Chest radiograph shows an elevated right hemidiaphragm. **b**. Repeat chest radiograph 2 months later showing resolution of the hemidiaphragm elevation

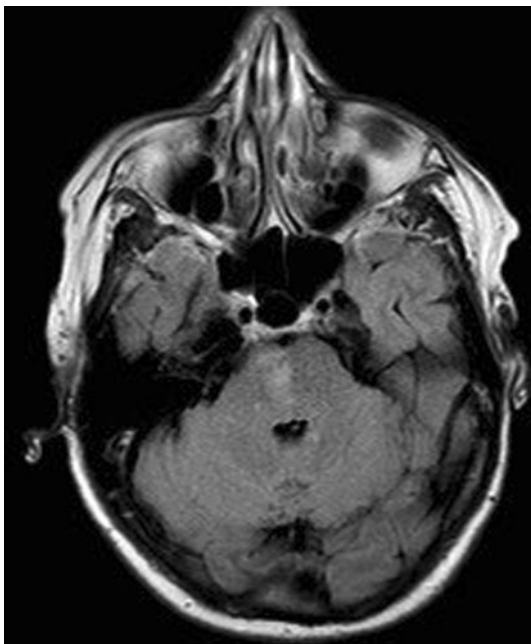


Fig. 2 MRI of the brain depicting an acute infarct involving the paramedian region of the right pons

Several studies have suggested impairment of voluntary activation of the diaphragm in cortical or subcortical unilateral lesions in patients with stroke. Furthermore, assessment of diaphragmatic movements or corticodiaphragmatic pathway in ischemic stroke patients has showed abolishment or retardation of diaphragm contraction [7–9].

In humans, most studies suggested that respiratory muscles are voluntarily activated via bilateral symmetric

pyramidal projections [9, 10]. Nevertheless, patients with acute ischemic stroke with unilateral lesions of the brain may develop contralateral diaphragmatic dysfunction; therefore, this diaphragmatic paresis is observed ipsilateral to the hemiplegic side. Only a few cases of ipsilateral diaphragmatic paralysis associated to unilateral brain lesions have been reported [11]. In a recent report, hemidiaphragm dysfunction was noted in a group of stroke patients. The diaphragmatic paresis observed in some patients may be due to ipsilateral diaphragmatic innervation [12].

In the case reported, the reversible diaphragmatic dysfunction developed contralateral to the hemiparetic side. This finding supports that in some patients the ipsilateral innervation of the diaphragm is more prominent than contralateral projections.

Conflict of interest The authors declare that they have no conflict of interest.

References

1. Wu MN, Chen PN, Lai CL, Liou LM (2011) Contralateral diaphragmatic palsy after subcortical middle cerebral artery infarction without capsular involvement. *Neurol Sci* 32:487–490
2. Kumar S, Reddy R, Prabhakar S (2009) Contralateral diaphragmatic palsy in acute stroke: an interesting observation. *Indian J Crit Care Med* 13:28–30
3. Aminoff MJ, Sears TA (1971) Spinal integration of segmental, cortical and breathing inputs to thoracic respiratory motoneurons. *J Physiol* 215:557–575
4. Gould L, Kaplan S (1967) A method of the production of hemidiaphragmatic paralysis. *Am Rev Respir Dis* 96:812–814

5. Gandevia SC, Rothwell JC (1987) Activation of the human diaphragm from the motor cortex. *J Physiol* 384:109–118
6. Nogués MA, Benarroch E (2008) Abnormalities of respiratory control and the respiratory motor unit. *Neurologist* 14:273–288
7. Cohen E, Mier A, Heywood P, Murphy K, Boulton J, Guz A (1994) Diaphragmatic movement in hemiplegic patients measured by ultrasonography. *Thorax* 49:890–895
8. Santamaria J, Ruiz C (1988) Diaphragmatic elevation in stroke. *Eur Neurol* 28:81–83
9. Khedr EM, El Shinawy O, Khedr T, Aziz Ali YA, Awad EM (2000) Assessment of corticodiaphragmatic pathway and pulmonary function in acute ischemic stroke patients. *Eur J Neurol* 7:323–330
10. Urban PP, Morgenstern M, Brause K, Wicht S, Vukurevic G, Kessler S et al (2002) Distribution and course of cortico-respiratory projections for voluntary activation in man. A transcranial magnetic stimulation study in healthy subjects and patients with cerebral ischemia. *J Neurol* 249:735–744
11. Schulz R, Fegbeutel C, Althoff A, Traupe H, Grimminger F, Seeger W (2003) Central sleep apnoea and unilateral diaphragmatic paralysis associated with vertebral artery compression of the medulla oblongata. *J Neurol* 250:503–505
12. Voyvoda N, Yücel C, Karatas G, Oguzülgen I, Oktar S (2011) An evaluation of diaphragmatic movements in hemiplegic patients. *Br J Radiol* (Epub ahead of print)