Case Report

An atypical neonatal hypoxic ischemic encephalopathy treated by hypothermia may hide a spinal cord lesion

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Keywords

spinal cord injury, therapeutic hypothermia, cooling, hypoxic ischemic encephalopathy, magnetic resonance imaging

Abstract

Neonatal spinal cord injury is a rare condition and its diagnostic might be delayed by concurrent hypoxic ischemic encephalopathy. Herein we describe a new-born presenting with hypotonia and respiratory failure after a traumatic delivery. After being treated for hypoxic ischemic encephalopathy by therapeutic hypothermia, her neurological evolution led to perform an magnetic resonance imaging which revealed an ischemic spinal cord injury at the level of C1-C2. Therapeutic hypothermia use is anecdotal in neonatal spinal cord injury but could have promising effects. Therapeutic hypothermia did not prevent the fatal outcome in this case. Recognizing risk factors and clinical features of spinal cord injury is crucial. A magnetic resonance imaging examination should be performed following the completion of therapeutic hypothermia.

Introduction

Neonatal spinal cord injury (SCI) is an extremely rare and serious complication. The estimated incidence ranges between 1/29,000 and 1/80,000 of live births (1,2). The diagnosis of neonatal SCI could be delayed by concurrent hypoxic ischemic encephalopathy (HIE) (2). Albeit widely recommended for HIE, therapeutic hypothermia (TH) is still experimental in SCI but could have promising effects. Indeed, TH slows down the cell metabolism and attenuates secondary processes of injury by vascular and biochemical modifications (3). To date, two cases of neonatal SCI were successfully treated by TH applied for 72 hours (2,4). When neonatal SCI is clinically suspected in patients with HIE treated by hypothermia, performing spine imaging is of paramount importance. Magnetic resonance imaging (MRI) provides the most accurate images of spinal cord. Hereafter, we describe a case of neonatal HIE requiring TH, during which SCI was clinically suspected.

Unfortunately in our case, TH was not sufficient to improve the medical condition of this new-born. Nevertheless, this sad clinical situation points out two different reflections. Firstly, the optimal window of MRI will be discussed in the light of the maintenance of TH for 72 hours while shortly delaying the diagnosis of SCI. Secondly, we will highlight the neurological findings that could lead to an earlier diagnosis of SCI.

Case Report

A female infant was born at 39 weeks of gestation with a birth weight of 3,000 g. She is the first child of healthy and unrelated parents with no family history of any neurological disease. The pregnancy was unremarkable. The foetus presented in occiput posterior position, without any evidence of head hyperextension during labour. Due to foetal distress the delivery was initially assisted by a vacuum device and then by forceps associated with a Mac Roberts manoeuvre. At birth, endotracheal intubation was required for respiratory failure and hypotonia. Apgar scores were 1 at 1 minute, 3 at 5 minutes and 4 at 10 minutes. The infant was then admitted to the neonatal intensive care unit. All criteria of severe HIE were present including profound metabolic acidosis (i.e. pH value of 6.88), low Apgar score (i.e. less than 5 at 10 minutes), mechanical ventilation needs after 10 minutes of life, and the short-term electroencephalogram (EEG) registered in the first hour of life showed *major abnormalities* according to the Pressler classification (5). Therefore, whole-body TH was started one hour after admission and planned for 72 hours. After 24 hours, biological parameters normalized. At 20 hours of life, the EEG shows a continuous activity with *mild abnormalities* according to Pressler. Despite EEG improvement, the neurological evolution was still a concern. No spontaneous breathing appeared. Flaccid quadriplegia was obvious with areflexia: no patellar, Achilles neither biceps reflex. Only facial movements were present with normal pupillary light reflex. This clinical picture motivated the realization of a brain and cervical spine computed tomography (CT)-scan at 36 hours of life, which ruled out intracranial and spinal haemorrhage (figure 1). After 72 hours of TH, no clinical improvement occurred. Brain and cervical spine MRI were subsequently obtained at 120 hours of life. While brain MRI showed no signs of encephalic ischemic lesions, cervical spine MRI revealed a high signal lesion in T2 and a low signal in T1 weighted images. The diffusion was restricted in the medulla at the C1-C2 level (figure 2). Given the severity of the lesion and no respiratory recovery, palliative care was initiated and the infant died at 9 days old.

Discussion

New-borns' spinal cord is typically less elastic than the cartilaginous vertebral column and is therefore more vulnerable to rotational forces, explaining why a history of difficult delivery is often reported. Cephalic deliveries are more often associated with upper cervical spine lesions by torsion forces, while breech deliveries are related to lower cervical and upper thoracic lesions by traction forces (1,6). Mechanisms of SCI include compression, ischemia and traumatism or tearing of the spinal cord (1,7). Tearing is the most common cause of neonatal SCI as opposed to the compression injuries which mainly occur in adult patients (6). As the spinal cord contains capillaries in the grey and white matters, it makes it vulnerable to hypoxic ischemic lesions, explaining why SCI is often associated with HIE (1).

In addition to those primary lesions, after a few hours or days, a wide range of secondary injury mechanisms might develop. According to experimental studies, TH would act on the secondary injury process. Those mechanisms include haemorrhage, ischemia-reperfusion, excitotoxicity and inflammation leading to apoptosis (3, 8).

In neonates with HIE, the diagnosis of SCI should be ruled out in the case of respiratory failure and severe hypotonia, while EEG and biological parameters improve unexpectedly, particularly in an assisted, breech or difficult deliveries. The other neurological findings that could lead to the diagnosis are areflexia, sensory level, distended bladder and atonic anal sphincter. The clinical manifestations depend on the level and extend of the lesion. Spasticity can occur later (6).

A careful neurological exam can suggest the diagnosis, but complementary imaging is necessary. CT-scan of the cervical spine allows early detection of haemorrhagic compressive lesions and bone injuries, which rarely occur due to the cartilaginous skeleton of neonates. Yet almost 15% of spinal injuries are missed on CT-scan (9).

MRI is the gold standard for assessment of tissue damage in SCI. Spinal MRI informs on the type, localization and extent of the lesion and contributes to the prognosis. Lower cervical and upper thoracic lesions are associated with better outcomes than upper cervical ones (1,6). Spinal cord haemorrhage has the poorest outcome, while compression and ischemia of the spinal cord are less severe and more reversible (1,10). In adults, a first MRI assessment is recommended between 24-72 hours post trauma (9). The diagnosis of SCI could be missed if MRI is performed too early, as sensitivity to detect haemorrhage increases with time as well as the extent of oedema in spinal cord (10). Therefore, performing MRI after TH completion may be judicious for a better accuracy of detection.

In some patients SCI can co-occur with HIE and meet the criteria of TH. Cooling must be performed to reduce mortality and major neurodevelopmental disability in newborns with moderate to severe HIE. TH is mostly beneficial when initiated before 6 hours of life and lasting for 72 hours. The neuroprotective effect of hypothermia has been demonstrated in adults with SCI but there are still doubts that prevent from its general use. In neonates, TH applied for 72 hours has been reported in only three cases of SCI among which one death occurred (2,4,8). No clinical trial about TH in neonatal SCI has ever been conducted. In adult's series, cooling was applied for up to 48 hours, but longer period does not seem harmful (3). TH is a promising neuroprotective treatment for SCI and may be reasonably started or continued in case of clinically suspected SCI in neonates.

Conclusion

In conclusion, the diagnosis of neonatal SCI is challenging and could be delayed by coexisting clinical signs of HIE. An accurate neurological examination might suggest the diagnosis. TH is a promising neuroprotective treatment for SCI and may be reasonably started or continued in case of clinically suspected SCI in neonates with HIE. The optimal window for MRI might be right after TH, to allow for a complete treatment and a better sensitivity of lesion detection. Nevertheless, these lesions are often severe and irreversible as shown in our case.

Statement of Ethics

The paper has been sufficiently anonymised not to harm any patient's family and the publication of this case report has been approved by the human research ethics committee of Queen's Fabiola Children's Hospital on the 22nd April 2020.

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Figure 1 : *Non-contrast low-dose head and neck CT-scan (helicoidal CT scanner Somatom Siemens 64) in a) sagittal reconstruct and b) in axial reconstruct, both of them in soft Kernel. (A) High density subdural collection along the tentorium (subdural hematoma) along with a decrease density of the medulla at the C1-C2 level (black arrow). (B) Axial plane MPR showing medullary hypodensity at the C1-C2 level on the left (black arrow) and normal medullary density on the right.*

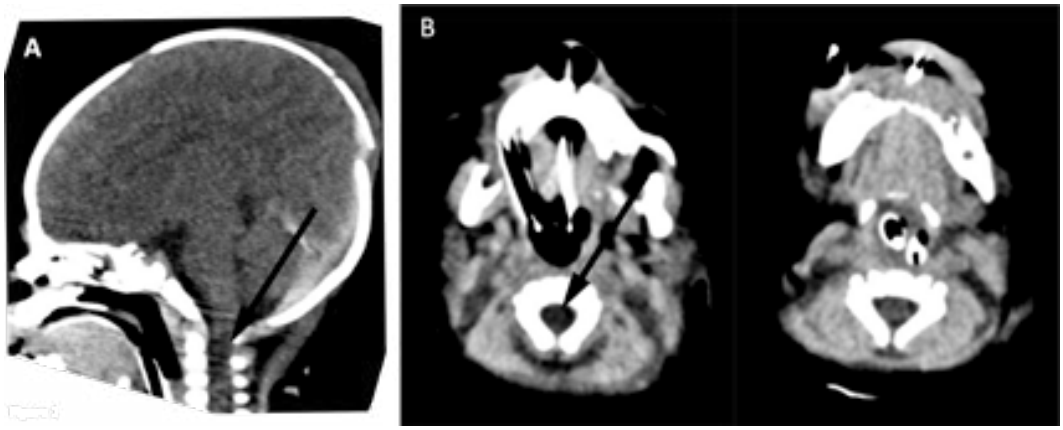

Figure 2 : *1,5 Tesla MRI scanner (Siemens Area) of the brain and spine without contrast in a) diffusion weighted imaging (TRACE) on the left and apparent diffusion coefficient (ADC MAP) on the right and b) T1-weighted sagittal brain and spine on the left, sagittal T2-weighted imaging in the middle and on the right. (A) Signal abnormality in the cervical medulla at the level of C1-C2 showing a high signal in DWI and low signal on ADC MAP illustrating the post anoxic-ischemic lesion of the cervical medulla. (B) Sagittal planes showing the ischemic medullary lesion at the C1-C2 level (lower white arrow) associated with a retrograde Wallerian degeneration of the pons (upper white arrow)*