

CASE REPORT

Watershed stroke - an unexpected complication of respiratory syncytial virus bronchiolitis: a case report

Garan Riley¹, Christopher D Rittey², Daniel JA Connolly³, Santosh R Mordekar^{2*}

ABSTRACT

Background: Respiratory syncytial virus (RSV) is a common childhood respiratory pathogen, with many reported extrapulmonary manifestations. Neurological involvement was once believed to be temporary or reversible.

Case presentation: We report a case of watershed stroke in a young child, occurring as an unexpected complication of severe RSV bronchiolitis. Unexpectedly, brain diffusion-weighted MRI proved that seizures in our patient were a consequence of more significant peripheral perfusion failure and stroke.

Conclusion: It is important to distinguish the reversible effects of RSV from those alternative pathological sequelae necessitating changes in clinical management and re-prognostication.

Keywords: Infarction, seizure, Respiratory Syncytial Virus, case report.

Background

Watershed infarction (WSI) is a type of stroke attributed to perfusion failure at the periphery of adjacent non-anastomosing arterial territories in the brain. Various pathophysiological origins have been alluded to—such as systemic hypotension, arterial stenosis/occlusion and microemboli [1-3]. In the newborn, after 36 weeks gestational age, it is generally thought to arise from severe systemic hypotensive episodes ± hypoxemia [4]. WSI can be a devastating event, as profound neurological disability and even death may ensue. Such sequelae could be curtailed in the young child with promising new neuroprotective techniques if introduced early [5].

The Pediatrician and the Pediatric Radiologist should be alert to watershed stroke and to the gamut of childhood conditions having an ascribed causal association. To our knowledge, no such association has been reported with respiratory syncytial virus (RSV) infection.

We bring to your attention a case of peripheral perfusion failure and watershed stroke as an unexpected complication of severe RSV-positive bronchiolar infection in a young child.

Case presentation

The child was a boy born pre-term at 28 weeks' gestation by emergency caesarean section for maternal pre-eclampsia, weighing 937 grams and with a head circumference of 26.5cm (50th centile). Following 2 months intensive care treatment for surfactant-deficiency pulmonary disease, he was discharged home with continuous low flow oxygen therapy. Co-existing conditions of prematurity included patent ductus arteriosus and foramen ovale, osteopenia with long bone fractures and gastro-esophageal reflux. Neurological examination and cranial ultrasound scans were unremarkable at the time

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of discharge.

At 3 months of age, he was re-admitted to the pediatric intensive care unit (PICU) with acute bronchiolitis, diagnosed clinically. Chest radiograph and subsequently nasal washings confirmed the patient as RSV-positive. He required endotracheal intubation and ventilation for 48 hours. During that time, he developed pneumothoraces that were successfully drained. Throughout his stay in PICU, blood pressure remained stable with no observed periods of hypotension. Blood gas estimations during the PICU stay did not show any evidence of hypocarbia. Cardiovascular system examination revealed normal heart sounds with no murmurs.

On PICU day 3, he developed acute symptomatic focal seizures with secondary generalization, with corresponding electro-encephalogram (EEG) changes. Seizures were treated effectively with intravenous phenobarbital and midazolam. He was treated prophylactically on intravenous Cefotaxime and Acyclovir. Lumbar puncture

showed normal microscopy, protein, glucose and lactate. CSF virology was negative for herpes simplex virus and, in particular for RSV.

Brain magnetic resonance imaging (MRI) was performed 12 hours after the onset of seizures, which demonstrated restricted diffusion in a pattern suggestive of acute watershed territory infarction [figures 1-3]. On day 22, the patient was discharged home without regular antiepileptic medications.

Clinical examination at 8 months chronological age (5 months corrected gestational age) demonstrated good head control on ventral suspension, appropriate use of both hands with hand-to-mouth co-ordination, and good visual tracking. He was fully orally fed. On examination, his head circumference was 39 cm (9th centile), with a normal tone and reflexes with no focal neurological signs. Clinical examination at 13 months chronological age (10 months corrected) demonstrated sitting unsupported, as well as weight-bearing and standing with support. He had

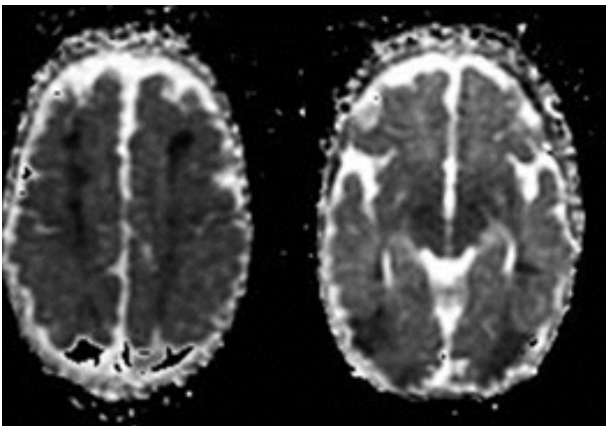


Figure 1: Diffusion weighted (b700) imaging (DWI) demonstrates high signal bilaterally in confluent linear stripes in the cerebral convexities parallel to the interhemispheric fissure and extending from the occipital horns of lateral ventricles to the parieto-occipital cortex, suggesting restricted diffusion and acute WSI.

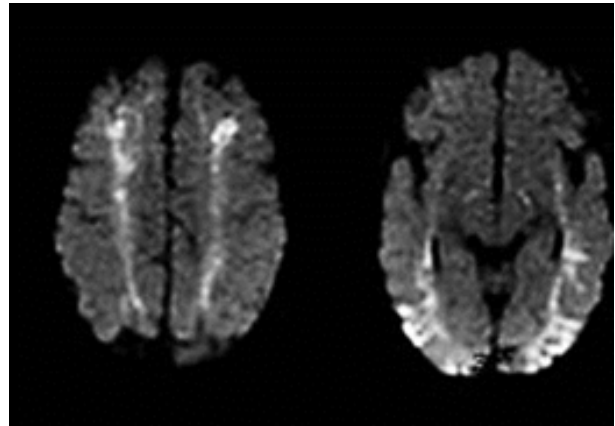


Figure 2: Apparent diffusion coefficient (ADC) maps demonstrate reduced values corresponding to the abnormalities at DWI, confirming restricted diffusion and acute WSI.

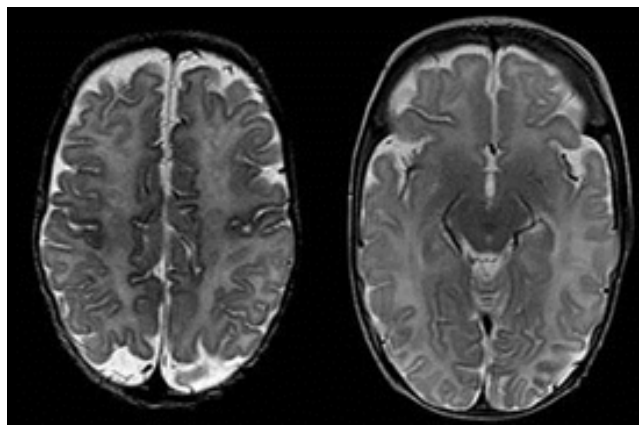


Figure 3: Axial T2-weighted imaging demonstrates subtle high signal abnormality, corresponding to the diffusion weighted imaging.

achieved hand to hand transfer of objects but no pincer grasp. As far as vocalization is concerned, he used both vowel and consonant babble. He blew raspberries, recognized his name but had no single words. On examination, his head circumference was 41.9 cm (< 0.4th centile). His weight and height were well below the 0.4th centile. His tone and reflexes were normal with no focal neurological signs.

Discussion

Our patient was admitted to PICU with severe RSV-positive bronchiolitis and episodes of respiratory decompensation requiring ventilator support and subsequently developed acute symptomatic seizures after three days. While seizures – among other acute neurological symptoms and signs – have been reported as temporary or reversible manifestations of RSV; [6-9] to our knowledge there are no such reports implicating WSI and stroke.

RSV is a common pathogen in childhood respiratory infections. Around 3% of all babies with bronchiolitis develop more serious symptoms, such as difficulty in breathing, that require hospital admission [10]. This is more common in premature babies and in those born with a heart or lung condition. Our case had several risk factors.

Extrapulmonary manifestations of RSV infection are becoming increasingly recognized as reasons for acute deterioration. Neurological manifestations were reported in 39% (n = 121) of RSV-positive bronchiolitis patients admitted to PICU. These included seizures, central apneas, lethargy, feeding/swallowing difficulties, muscle tone abnormalities, as well as elevated cerebrospinal fluid protein levels. In a previous study, 7 similar manifestations were found in 1.2% (n = 964) of ward-based patients – with milder bronchiolitis [8].

RSV-related seizures have been described as both generalized tonic-clonic and focal seizures with altered consciousness and focal motor features or eye deviation, as well as status epilepticus [7,8]. Encephalopathy was felt to be the cause of seizures in 1.8% (n=487) in a tertiary center study [9]. Hyponatremia is commonly associated with RSV and possibly accounts for some seizures [6,11]. Focal temporal lobe ‘slowing’ was seen on electroencephalogram in one case [8]. Generally, neuroimaging has proven non-contributory.

In our case, MR Neuroimaging appearances were characteristic of acute bilaterally symmetric cortical watershed infarction (WSI) (figure 1). WSI occurs at border zones between the territories supplied by 2 (or 3) non-anastomosing arterial systems – cortical WSI between anterior cerebral artery (ACA), middle cerebral artery (MCA) and posterior cerebral artery (PCA); and internal WSI between deep and superficial MCA or between superficial MCA and superficial ACA. Susceptibility of the border zone areas is thought to result from their situation at the ‘peripheral field’ where

perfusion pressure is lowest. Peripheral perfusion failure (ischemia) is the critical physiological process most likely secondary to precipitous drops in systemic arterial blood pressure rather than hypoxia [1]. Microembolic disease has also been implicated in the etiology of WSI [2-3].

The pathogenesis of WSI in our case of severe RSV-related bronchiolitis is uncertain; the general process is probably due to respiratory failure with asphyxia and/or periods of central apnea, resulting in reduced blood oxygenation (hypoxemia). With prolonged hypoxemia, cardiac hypoxia occurs, leading to diminished cardiac output and ultimately to brain hypoperfusion. Local brain tissue hypoxemia is probably contributory rather than the primary underlying cause of stroke, although this is difficult to confirm. RSV encephalitis is an unlikely cause in our case, with normal CSF analysis. And while conditions of prematurity pre-existed, these were shown to be stable or improving. Embolic phenomena are unlikely in this age-group.

The prognosis for children with watershed infarct is variable in the long term. Since our child is currently only 13 months of age and is meeting expected milestones, repeat MR Neuroimaging has not undertaken so far.

Our case will be closely monitored in Neurology Clinic, and follow-up imaging is considered at 3 years of age based on clinical need.

Conclusion

Severe RSV bronchiolitis could be complicated by watershed stroke, which warrants consideration in those patients with neurological manifestations.

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List of Abbreviations

ACA	Anterior cerebral artery
CSF	Cerebrospinal fluid
EEG	Electro-encephalogram
MCA	Middle cerebral artery
MRI	Magnetic resonance imaging
PCA	Posterior cerebral artery
PICU	Pediatric intensive care unit
RSV	Respiratory syncytial virus
WSI	Watershed infarction

Conflict of Interests

None

Funding

None

Consent for publication

Informed consent was obtained from the parents of the patient to publish this case in a medical journal.

Ethical approval

Ethical approval is not required at our institution for publishing a case report in a medical journal.

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Authors’ contribution

DJAC was responsible for recognizing the importance of publicizing the lessons of this case to the wider medical community. SRM, CR and GTR were involved with retrieving and collating the clinical details. GTR was the primary writer, and all authors provided advice for revision and important intellectual content.

All authors contributed to the management of the patient. All the authors approved the final version of the manuscript.

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Summary of the case

Patient (gender, age)	1	Male, 13 month old
Final Diagnosis	2	Watershed Stroke with Severe RSV positive bronchiolitis.
Symptoms	3	Severe RSV positive bronchiolitis at 3 months of age.
Medications (Generic)	4	Prophylactic IV Cefatoxime and IV Acyclovir
Clinical Procedure	5	MRI contrast with Diffusion weighted imaging.
Specialty	6	Pediatrics, Intensive care, Neurology
Objective	7	To report a case of watershed stroke in a young child, occurring as an unexpected complication of severe RSV bronchiolitis.
Background	8	3 months old baby presenting with severe chest infection needing intensive care admission with seizures
Case Report	9	A case of peripheral perfusion failure and watershed stroke as an unexpected complication of severe RSV-positive bronchiolar infection in a 3 month old boy.
Conclusions	10	Severe RSV bronchiolitis could be complicated by watershed stroke, which warrants consideration in those patients with neurological manifestations.
MeSH Keywords	11	Infarction, seizure, RSV, case report