Cyclical fluctuations in cerebral blood volume

L N Livera, Y A B D Wickramasinghe, S A Spencer, P Rolfe, M S Thorniley

Abstract

Cyclical fluctuations of cerebral blood flow velocity have been reported previously using Doppler ultrasound. The same phenomena was detected during investigations of changes in cerebral blood volume using near infrared spectroscopy. Rhythmic fluctuations of cerebral blood volume at a frequency of 3·5 cycles/minute is reported here.

Neonatal Intensive Care Unit, North Staffordshire Maternity Hospital, Stoke on Trent
L N Livera
S A Spencer

Department of Biomedical Engineering and Medical Physics, School of Postgraduate Medicine and Biological Sciences, University of Keele, Stoke on Trent
Y A B D Wickramasinghe
P Rolfe
M S Thorniley

Correspondence to:
Dr S A Spencer,
Neonatal Intensive Care Unit,
North Staffordshire
Maternity Hospital,
Hilton Road,
Stoke on Trent ST4 6SD.

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Anthony *et al* have recently reported cyclical variability (1·5–5 cycles/minute) in cerebral blood flow velocity (CBFV) as measured by pulsed wave Doppler ultrasound in both sick and healthy infants.[1] This is thought to represent cycling of cerebral blood flow and has been previously documented using similar techniques.[2] This phenomenon appears to be peculiar to the neonate, both preterm and full term, and has not been reported in adults.[1] It has been suggested that rhythmical changes in vessel calibre occur in an attempt to autoregulate cerebral blood flow.

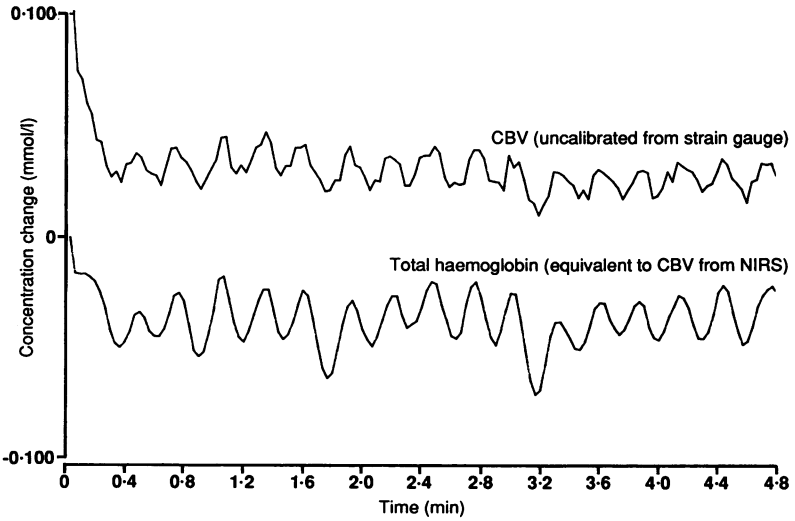
Patients and methods

We have been using near infrared spectroscopy (NIRS) to study changes in cerebral blood volume and cerebral oxygenation in preterm infants.[3] This technique enables the continuous monitoring of cerebral haemodynamics and is non-invasive. We report cycling of cerebral blood volume in a healthy preterm infant detected by NIRS. The observation was made fortuitously during a study to validate NIRS measurement of cerebral blood volume using jugular venous occlusion plethysmography.[4] Arterial blood pressure and transcutaneous blood gases were not monitored in this infant.

A girl of 31 weeks' gestation and 1735 g was studied at age 16 days. She had no major respiratory problems, and was healthy at the time of study with no ultrasound evidence of cerebral injury. The traces shown in the figure were collected while the infant was at rest in a quiet awake state. There was no significant variation in respiratory pattern or heart rate, and no procedures were performed during the period of study.

Results

The upper trace shows the strain gauge signal indicative of occipitofrontal circumference and the lower trace shows the change in total haemoglobin as measured by NIRS. There are simultaneous rhythmic fluctuations in both traces at a frequency of 3·5 cycles/minute. This simultaneous change in total haemoglobin and occipitofrontal circumference would indicate cyclical changes in cerebral blood volume.



Cyclical fluctuations in cerebral blood volume (CBV) detected by NIRS and strain gauge.

Discussion

The fluctuations in cerebral blood volume noted using NIRS and strain gauge plethysmography are of similar rate to that observed for CBFV using Doppler ultrasound. It seems likely that both phenomena have a common cause. The ultrasound determination of CBFV only relates to examination of one vessel, whereas NIRS and strain gauge plethysmography detect changes in cerebral blood volume over the whole cerebral vascular bed.[4] A change in cerebral blood flow is likely to affect both cerebral blood volume and CBFV.

The aetiology of these cyclical fluctuations is unclear. They have previously been reported in infants of up to 8 days of age, and have now been documented in a preterm infant of 16 days. Rhythmic variations in heart rate or arterial blood pressure have not been found in previous studies where cycling of CBFV was seen.[1] It is difficult to eliminate small cyclical changes in arterial concentrations of carbon dioxide using non-invasive techniques given the rapid response time that would be required. Anthony *et al* thought that a cyclical change in carbon dioxide tension causing cycling of CBFV unlikely as their infants were paralysed and ventilated.[1]

Cyclical changes in intracranial pressure have been noted in adults in association with coma, and have also been seen in severely asphyxiated

infants, usually with poor outcome. This is very unlikely to be the cause of cycling CBFV as the majority of infants where this has been seen had no evidence of brain injury. Similarly seizures which can affect intracranial pressure and cerebral blood flow could theoretically cause such cycling, but no evidence of fits has been found in the babies studied. In our infant there was no history of asphyxia and clinically no evidence of convulsions.

The primitive phenomenon of an immature autoregulatory response suggested by Anthony *et al* remains the most likely mechanism.[1] Rhythmic changes in vessel tone occurring throughout both large and small arteries would result in the cycling in cerebral blood volume seen in our infant. It would be interesting, though technically very difficult, to use both Doppler and NIRS simultaneously to clarify this further. The clinical significance of this cycling pattern remains unclear.

Finally, it is clear that NIRS can detect changes in cerebral blood volume giving an indication of changes in cerebral blood flow. It is thus a useful monitoring technique that may serve to improve understanding of the pathophysiology of neonatal brain injury.

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Neonatal renal candidal bezoar

V K Rehan, D C Davidson

Abstract

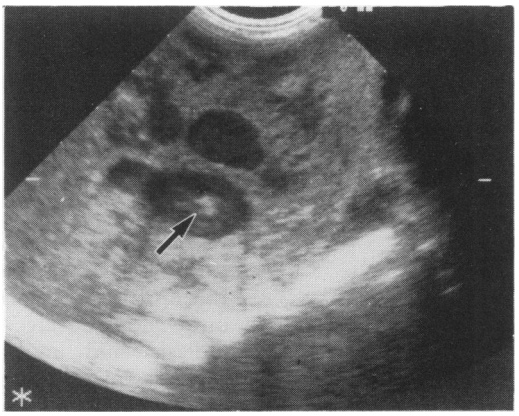
Renal candidal bezoar is uncommonly encountered in neonatal intensive care. An affected neonate who improved only after surgical removal of obstructive fungus from the renal pelvis and local irrigation with amphotericin B is described. The need for early consideration of surgical intervention is stressed.

Candida albicans is ubiquitous in the neonatal environment. Although superficial candidal infections of skin and mucosa are common, disseminated candidiasis and specific visceral candidal involvement occur infrequently and fungal obstruction of the urinary tract poses a specific management problem.[1] Predisposing factors include prematurity, intravascular catheters, broad spectrum antibiotics, immunosuppression, and total parenteral nutrition.[2]

Case report

A boy weighing 900 g was delivered at 27 weeks' gestation. The Apgar scores were 7 and 8 at 1 and 5 minutes respectively. He was electively ventilated from 20 minutes of age and transferred to us, aged 7·5 hours. Ventilatory support was required for idiopathic respiratory distress. By 40 days of age he had been weaned from the ventilator. He required phototherapy, parenteral nutrition, and repeated courses of antibiotics for proved bacterial infections. He developed posthaemorrhagic hydrocephalus that arrested spontaneously. By 2 months of age he was feeding, thriving, and was discharged.

At the age of 10 weeks he was readmitted for elective cryotherapy for stage 3+ retinopathy of prematurity. He appeared unwell, was moderately jaundiced, had abdominal distension, hepatosplenomegaly, and a palpable left kidney. An abdominal ultrasound scan showed bright echoes in the left renal pelvis compatible with a candidal bezoar (figure). *C albicans* was repeatedly cultured from blood and urine. The plasma urea concentration rose from 3 to 19 mmol/l and the serum creatinine from 40 to 145 μmol/l. Amphotericin B was started as an intravenous infusion over six hours at 100 μg/kg/day and gradually increased to 500 μg/kg/day over five days. Flucytosine in a dose of 100 mg/kg/day in four divided doses as an intravenous infusion over 30 minutes was also given. Two weeks later, despite systemic antifungal treatment, there was neither clinical nor biochemical improvement and both urine and blood cultures remained positive. *C albicans* was reported as sensitive to flucytosine and amphotericin B and serum concentrations were in excess of the minimum inhibitory concentration in vitro. An echocardiogram showed no evidence of valvular vegetations. A decision was made to use local antifungal treatment. A nephrostomy tube was placed percutaneously in



Ultrasound scan of left kidney in the long axis showing echobright lesion (bezoar) in renal pelvis.

Royal Liverpool Children's Hospital, Alder Hey, Eaton Road, Liverpool L12 2AP
V K Rehan
D C Davidson

Correspondence to:
Dr Rehan.

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