



## CLINICAL IMAGES

## Usefulness of neuro-imaging for the diagnosis of HIV encephalopathy in children

J R Kieck, S Andronikou

It is important to recognise the central nervous system (CNS) imaging appearances of HIV, in particular those of HIV encephalopathy, as this is an AIDS-defining illness. HIV encephalopathy is a common manifestation of HIV, with distinct neuro-imaging features. With the use of images we aim to draw the clinician's attention to the neuro-imaging modalities best suited to demonstrating these features.

Neurological dysfunction in AIDS is common, occurring in as many as 80% of children.<sup>1</sup> The spectrum of diseases includes HIV encephalopathy, cerebrovascular disease, PML (progressive multifocal leuko-encephalopathy), infections and malignancies. Opportunistic CNS infections are extremely rare in paediatric AIDS patients compared with adults,<sup>2,4</sup> even in the presence of systemic infections by *Pneumocystis carinii* pneumonia, candida and cytomegalovirus (CMV) (CMV being the most common paediatric opportunistic infection).<sup>3</sup> Toxoplasmosis is almost never seen in young children.<sup>3,5,6</sup> Lymphoma (4% of HIV-positive children)<sup>6</sup> is more common than toxoplasmosis,<sup>3,5,6</sup> but is also not commonly encountered in paediatric practice. The JC virus is considered an opportunistic infection and manifests as PML, which is still rare in children.<sup>3,5,7,8</sup> The imaging manifestations of CNS infections, malignancies and vascular diseases fall outside the scope of this article.

Up to 76% of asymptomatic HIV-positive children are found to have at least one abnormality on computed tomography (CT).<sup>3</sup> Chamberlain *et al.*<sup>1</sup> found that 40% of HIV-positive children have abnormal CT or magnetic resonance imaging (MRI) scans by the age of 1 year. The most common findings on imaging are cerebral atrophy<sup>1-4,6</sup> and basal ganglia calcifications.<sup>1-4,6</sup> White matter changes related to HIV itself are less common,<sup>1,3</sup> but occur more frequently than PML.<sup>5,8</sup>

### Recommended imaging

Gavin *et al.*<sup>3</sup> recommend routine CT scanning in the first year of life. The United States Public Health Service recommends a baseline study upon confirmation of the diagnosis of HIV.<sup>6</sup> CT is very sensitive for basal ganglia calcification,<sup>3,4,6</sup> atrophy (just as

good as MRI),<sup>1,6</sup> acute haemorrhage and focal lesions, e.g. lymphoma and stroke. MRI is not routinely recommended,<sup>1,3</sup> although it has been found to be better at detecting aneurysms,<sup>9</sup> white matter demyelination,<sup>1,3,4,6,8</sup> foci of toxoplasma<sup>6</sup> and infarcts.<sup>6,9</sup> Serial studies are not routinely recommended unless response to treatment needs to be evaluated or progression of disease documented.<sup>3</sup> Chamberlain *et al.*<sup>1</sup> stated that MRI is indicated only in children with new-onset seizures or focal CNS mass lesions on CT.

### HIV encephalopathy

HIV itself is responsible for the encephalopathic process that complicates AIDS, and the presence of encephalopathy in an HIV-positive child is an AIDS-defining event.<sup>3</sup> The prevalence of CNS dysfunction ranges from 20% to 60%<sup>3</sup> to 80%.<sup>1</sup> Ninety per cent of the children in one study were encephalopathic.<sup>4</sup> The diagnosis of encephalopathy is based on a combination of neurological examination, neurodevelopmental assessment and neuro-imaging.<sup>3</sup> It may be either static or progressive clinically.<sup>3,4,6</sup> Encephalopathy manifests as cerebral atrophy and leuko-encephalopathy seen radiologically as prominent surface markings with ventriculomegaly and signal abnormalities on MRI respectively. Basal ganglia calcification is a frequently seen association and is not a feature in adults.<sup>3,4</sup> Cerebral atrophy and basal ganglia calcification remain the most frequent positive findings in neuro-imaging.<sup>1,4</sup>

Generalised atrophy (Fig. 1) is seen in up to 90% of HIV-positive children.<sup>4,6</sup> Central atrophy is more prominent than cortical atrophy (which is usually in the frontal lobes),<sup>6</sup> because of the predilection of HIV for the basal ganglia, causing necrosis.<sup>3,6</sup> This manifests radiologically as ventriculomegaly disproportionate to the degree of cortical atrophy. In their study Gavin *et al.*<sup>3</sup> also found 68% of HIV-positive symptomatic children to have cerebral atrophy and 78% to have ventriculomegaly. CT was found to be just as good as MRI for detecting atrophy.<sup>1,6</sup>

White matter changes (Figs 2a, b) in association with atrophy are not seen frequently (9%,<sup>2</sup> 27%<sup>3</sup>), but are important to recognise. This is thought to be a sign of advanced disease<sup>3,6</sup> and manifests as low density on CT,<sup>1,4,6</sup> hypo-intensity on T1<sup>6</sup> and hyperintensity on T2 MRI images.<sup>1,3,6,8</sup> The most common site is the periventricular white matter<sup>1,3,6,8</sup> and less commonly the

Jackie Kieck is a registrar in radiology at UCT, and at the time of writing Savvas Andronikou was in the Department of Paediatric Radiology at Red Cross Children's Hospital. He has since taken up the chair of radiology at Wits.

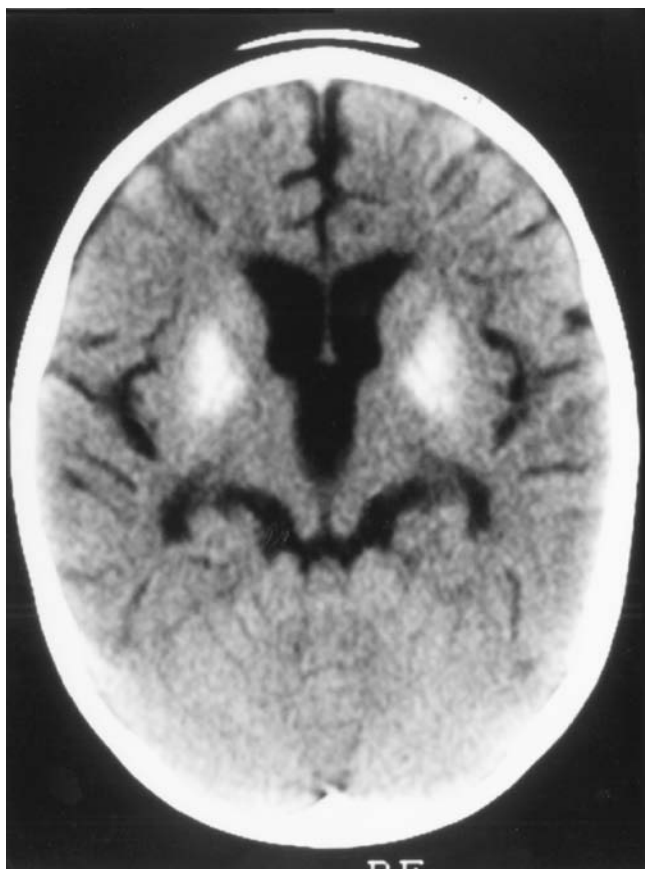
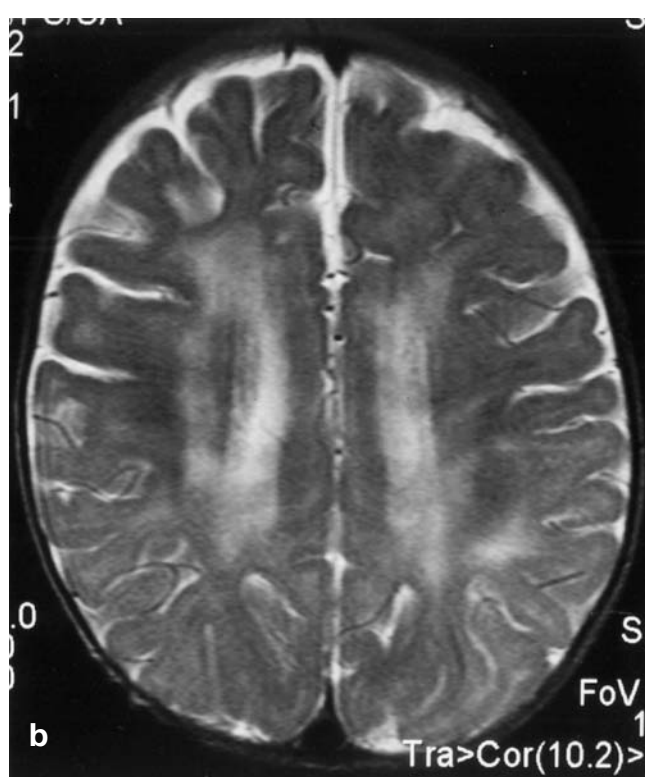
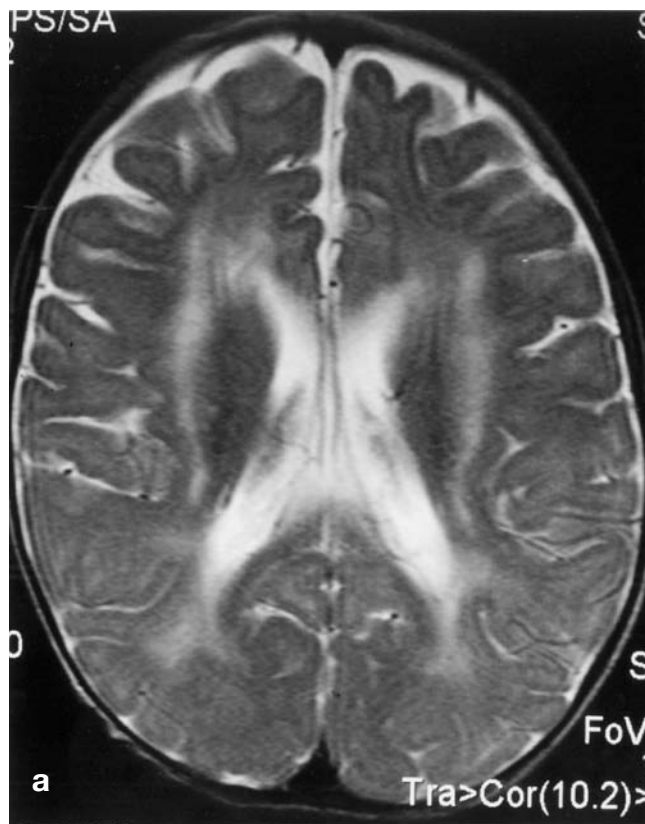


Fig. 1. Axial non-contrast CT of the brain demonstrates ventriculomegaly out of proportion to the degree of surface marking prominence. This indicates predominantly central atrophy due to basal ganglia necrosis, compared with the degree of cortical atrophy.

centrum semi-ovale.<sup>6,8</sup> It is important to remember that myelination in the centrum semi-ovale is only complete after the age of 18 months and this should not be mistaken for demyelination.<sup>6</sup> No mass effect or contrast enhancement has been reported.<sup>4,6,8</sup> Changes may be diffuse, punctate<sup>8</sup> or patchy.<sup>4,8</sup> Although MRI is more sensitive in detecting white matter demyelination,<sup>1,3,4,6,8</sup> it is not felt to have significant advantage over CT, as these white matter changes are common.<sup>1</sup> It is important to distinguish between HIV encephalopathy, white matter changes and PML (Fig. 3), as PML has been reported in the paediatric age group<sup>5,7</sup> and has a much poorer prognosis.<sup>5,7,8</sup> PML differs in that it is much rarer, typically subcortical, may enhance post contrast<sup>5,8</sup> and tends to be more asymmetrical.<sup>6</sup> Lesions may also more often be hypo-intense on T1 MRI images than HIV encephalopathy changes.<sup>8</sup> Patients die within 9 months of the onset of symptoms.<sup>8</sup>

Basal ganglia calcification (Fig. 1) is unique to vertically infected children,<sup>3</sup> is one of the most frequent CNS imaging findings in paediatric AIDS,<sup>1,4</sup> and is always found in combination with atrophy.<sup>4</sup> It is not a feature in adult AIDS.<sup>3,4</sup> The prevalence varies from 19% to 53%.<sup>2,4,6</sup> The calcifications are never seen before the age of 1 year<sup>4,6</sup> and are always associated



Figs 2a and b. Axial T2-weighted MRI of the brain demonstrating the white matter hyperintensity related to HIV encephalopathy. (a) Bilateral deep white matter hyperintensity, which is periventricular and symmetrical. (b) Axial image above the level of the lateral ventricles shows the superior extent of the leuko-encephalopathy involving the centrum semi-ovale.



Fig. 3. Axial T2-weighted MRI of the posterior fossa demonstrating features of PML with asymmetrical hyperintensity in the left brachium pontis and cerebellar hemisphere. This HIV-positive child had proven JC virus infection.

with an abnormal neurological examination.<sup>3,4,6</sup> If calcifications are seen before 2 months they are most likely due to other congenital infections, e.g. toxoplasmosis or rubella.<sup>3,6</sup> The degree of calcification is thought to be directly proportional to the viral load<sup>2,3</sup> and severity of encephalopathy.<sup>3,6</sup> At autopsy a calcific vasculitis is found<sup>2,4,6</sup> in 80 - 100% of cases.<sup>2,4,6</sup> The imaging features are bilateral, symmetrical hyperdensities on CT<sup>4,6</sup> involving the globus pallidus and putamen.<sup>6</sup> Cerebellar calcifications have also been reported.<sup>4,6</sup> White matter calcification may be seen, but only in association with basal ganglia calcification and almost always in the frontal lobes.<sup>6</sup> MRI is not as sensitive as CT in detecting calcification<sup>1,3,4,6</sup> and CT remains the investigation of choice.

## Conclusion

Both CT and MRI are useful imaging techniques for demonstrating the atrophy associated with HIV encephalopathy. CT has the advantage in demonstrating the calcification of basal ganglia seen in vertically acquired HIV, while MRI is the modality of choice for demonstrating white matter abnormalities. A baseline CT or MRI should be performed in children with HIV as HIV encephalopathy is an AIDS-defining illness.

1. Chamberlain MC. Pediatric AIDS: A longitudinal comparative MRI and CT brain imaging study. *Journal of Child Neurology* 1993; 8: 175-181.
2. Johann-Liang R, Lin K, Cervia J, Stavola J. Neuroimaging findings in children perinatally infected with the human immunodeficiency virus. *Pediatric Infectious Disease Journal* 1998; 17: 753-754.
3. Gavin P, Yogev R. Central nervous system abnormalities in pediatric human immunodeficiency virus infection. *Pediatric Neurosurgery* 1999; 31: 115-123.
4. Kauffman WM, Sivitt CJ, Fitz R, et al. CT and MR evaluation of intracranial involvement in pediatric HIV infection: A clinical imaging correlation. *AJNR* 1992; 13: 949-957.
5. Morris MC, Rutstein RM, Rudy B, et al. Progressive multifocal leukoencephalopathy in an HIV-infected child. *Paediatric Neuroradiology* 1997; 39: 142-144.
6. Safriel Y, Haller J, Lefton D, et al. Imaging of the brain in the HIV-positive child. *Pediatric Radiology* 2000; 30: 725-732.
7. Berger JR, Pall L, Lanska D, et al. Progressive multifocal leukoencephalopathy in patients with HIV infection. *Journal of Neurovirology* 1998; 4: 59-68.
8. Whiteman ML, Post MJ, Berger JR, Tate LG, Bell MD, Limonte LP. Progressive multifocal leukoencephalopathy in 47 HIV-seropositive patients: neuroimaging with clinical and pathologic correlation. *Radiology* 1993; 187: 233-240.
9. Patsalides A, Wood L, Atac G, Sandifer E, Butman JA, Patronas NJ. Cerebrovascular disease in HIV infected pediatric patients: neuroimaging findings. *AJR Am J Roentgenol* 2002; 179: 999-1003.

## CLINICAL IMAGES

### Hook line and sinker

A O Laosebikan, V Manchev, S R Thomson

Previously reported in this journal was the image entitled 'Hook line and finger'.<sup>1</sup>

We would like to report that we have now found the 'sinker'. The iron bar weighed in at 2.5 kg and was retrieved by colotomy (Fig. 1).

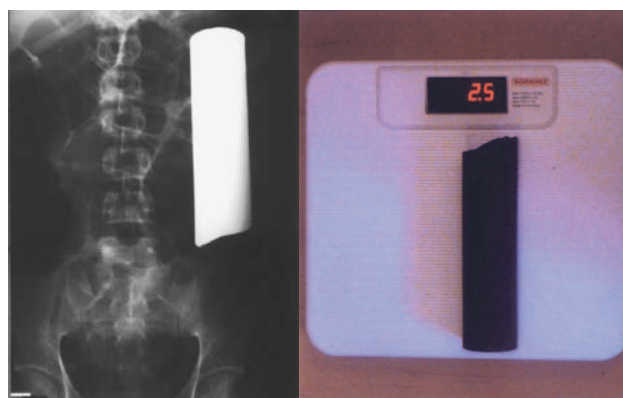


Fig. 1. The bar in the sigmoid colon (as seen on a plain abdominal radiograph) and at weigh-in.

1. Anderson F, Thomson SR. Hook line and finger. *S Afr Med J* 2001; 91: 494.

A O Laosebikan is a consultant surgeon at Grey's Hospital, Pietermaritzburg, where such extremes are rare. V Manchev, a graduate from Bulgaria with keen interest in surgery, is currently working as a medical officer at Grey's Hospital. S R Thomson is a Durban beachfront professor whose hospital is adjacent to the red light district where many, but obviously not all, such incidents occur.