

# Is the routine use of intravenous contrast justified in the work-up of adult-onset seizure patients with a normal pre-contrast brain scan?

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## Abstract

The indications for the administration of intravenous contrast media to adult patients presenting with first-time seizures and a normal pre-contrast study are not clear. A retrospective audit of such patients was done and compared with the post-contrast study. In our study sample of 205 patients all the post-contrast scans were reported as normal, indicating that contrast can be omitted if the pre-contrast study was normal. This only applies to computed tomography, and magnetic resonance imaging was not included.

## Introduction

There are few clear guidelines for registrars concerning the administration of intravenous (IV) contrast after a normal pre-contrast CT scan. The general consensus is that one has to administer contrast in order to 'play it safe' in case some obscure lesion is present that will only make itself visible when coaxed with iodine.

However, this practice multiplies the radiation exposure to the patient, has cost implications, and lengthens the overbooked scan lists typical in most academic hospitals.

The literature is not very helpful in this regard and a Medline search revealed a single study<sup>1</sup> commenting on the use of IV contrast in first-episode seizure patients with a normal pre-contrast scan. This study, performed at the University Hospital of the West Indies, concluded that the addition of contrast agents added no diagnostic benefit and that their routine use is not justified. However, only 48 (15%) patients in this study sample had a pre- and post-contrast study, and these included neonates and

children in whom congenital anomalies were more common and contrast administration was not essential.

The extent to which post-contrast studies increased the detection rate when the pre-contrast scan was normal is not clear in the literature.<sup>2,3</sup> Greenberg *et al.*<sup>4</sup> recommended that for studies in the emergency setting only pre-contrast scans should be done, the need for contrast or magnetic resonance imaging (MRI) being determined at a later stage. In this study all the abnormalities were evident on the pre-contrast images.

Brain CT studies done in Brazil<sup>5</sup> revealed that vascular, neoplastic and infective causes did not contribute significantly to the overall incidence of first-episode seizures, but that neurocysticercosis, trauma and cryptogenic causes did.

As part of the work-up for first-episode seizures in adults at the Pretoria Academic Hospital (PAH), pre- and post-contrast CT is usually requested. The trend that seemed to emerge was that this subgroup of patients usually had normal post-contrast scans when the pre-contrast scan was also normal. It was decided to test this observation because of the benefit of reduced radiation to the patients and cost savings to the department.

## Method

A retrospective study was done from 1 April 2002 to 31 December 2004. Exclusion criteria were age under 13 years, an abnormal pre-contrast study, acutely ill or post-traumatic patients, previously diagnosed epileptics, a history of carcinoma, urgent referrals from the Casualty Department, and status epilepsy.

Only patients referred from the

Neurology Outpatient Department of the PAH were included in this study. They were all asymptomatic at the time of the scan and had had their seizure(s) several weeks before.

Their reports were analysed and sorted into two groups:

1. Normal post-contrast study (including age-related changes and normal variants).

2. Clearly pathological post-contrast study.

The sample size was 205 patients with a one-sided null hypothesis value of  $p = 0.95$ .

## Results

Of the sample 100 (48.8%) were male and 105 (51.2%) female. The average age was 32.5 years. The most common seizure type was general tonic-clonic (179), followed by focal seizures (12), partial complex seizures (8) and absences (5). There was 1 case of temporal lobe epilepsy.

The age and sex distribution for the above seizure types is summarised in Table I.

The patients were then classified into one of two groups according to their CT scan findings. All 205 fell into group 1, as had been expected from previous experience.

The findings are summarised in Table II.

Age-related changes, found in 11 patients, were as follows: atrophy — 8

**Table II. Scan findings**

Normal post-contrast studies	
Normal pre-contrast	186
Age-related changes	11
Normal variants	8

patients (mean age 54.8 years), periventricular ischaemic gliosis — 3 (65 years). Normal variants, found in 8 patients, were as follows: falx calcification — 3 patients (mean age 45.7 years), cavum septum pellucidum — 2 (25.5 years), mega cisterna magna — 1 (13 years), asymmetrical lateral ventricles — 2 (28 years).

## Discussion

It is now widely accepted that the best imaging modality for suspected intracranial pathology is MRI.<sup>6</sup> Unfortunately this modality is not yet available routinely for patients at PAH.

In April 2002 a Siemens Somatom Multidetector CT was installed which significantly improved scanning duration and resolution compared with previous scanners. Subtle differences in densities were much easier to appreciate and the powerful software made reconstructions in any plane quick and simple.

The perception emerged among the radiological staff that if nothing abnormal was noted on the pre-contrast scan, a post-contrast study was probably unnecessary in all cases of

adult-onset seizures.

Analysing the results of our retrospective audit yielded a highly significant 100% correlation between the pre- and post-contrast scans. The confidence interval was 0.99 ( $p < 0.0031$ ), indicating that the chance of missing a lesion because a post-contrast scan was not done is less than 1%.

We conclude that no real additional benefit is gained from administering IV contrast to a patient in whom no relevant abnormality is seen on a pre-contrast scan.

General tonic-clonic convulsions were by far the commonest type of seizure seen in our study, which is in accordance with findings reported in the literature.<sup>7</sup> No significant difference in prevalence was found between males and females. Often no structural lesion is found in the generalised epilepsies, irrespective of the imaging modality used. However, patients with partial epilepsy tend to have structural lesions known pathologically to be associated with this disorder, e.g. hippocampal sclerosis, cortical malformations, low- to very low-grade neoplasms, angiomas or malformations and focal cortical damage.<sup>8</sup> Only the last two abnormalities can be imaged with any degree of certainty with CT, the rest requiring MRI for definitive exclusion. Lesions may therefore be missed when CT only is used in the

**Table I. Seizure types**

	Tonic-clonic	Focal	Absence	Partial complex	Temporal lobe
N	179	12	5	8	1
Mean age (yrs)	36.8	30.9	41.6	25.3	28
Males	87	4	1	4	-
Females	92	8	4	4	1

work-up, highlighting the necessity for MRI under these circumstances. Partial epilepsy also occurred in the youngest age group (mean age 25.3 years), in which any delay in establishing the diagnosis of a treatable cause will have a significant negative impact.

As expected, the most common age-related changes were atrophy and periventricular ischaemic gliosis. The low mean age for atrophy in this series was influenced by 2 patients in their 30s with a history of alcohol abuse.

Normal variants were uncommon (3.9%) with cavum septum pellucidum, asymmetrical lateral ventricles and falx calcifications having an almost equal incidence and a 2.5:1 female/male ratio.

Financially the savings from only doing pre-contrast studies amounted to approximately R100 000 ( $205 \times R487$  per 50 ml Ultravist). These savings are in fact an underestimate as costs for associated minor consumable items were not included.

## Conclusion

The definitive modality for work-up in patients with adult-onset seizures is MRI. Failing that, it is reasonable to do a pre-contrast CT scan and not to administer IV contrast if this study is normal. The likelihood of missing significant pathology would be less than 1%.

## References

1. Soares D, Reid M, Fenna A. CT in the evaluation of seizures at the University Hospital of the West Indies. *West Indian Med J* 2001; **50**: 151-154.
2. Taveras J. *Neuroradiology*. 3rd ed. Baltimore: Williams & Wilkins; 1996.
3. Heinz ER, Heinz TR, Radtke R, et al. Efficacy of MRI vs CT in epilepsy. *Am J Roentgenol* 1989; **152**: 347-52.
4. Greenberg MK, Barsan WG, Starkman S. Neuroimaging in the emergency patient presenting with seizure. *Neurology* 1996; **47**: 26-32.
5. Guerreiro CAM, Silveira DC, Costa ALC. Classification and etiology of newly diagnosed epilepsies in southeast Brazil. *Epilepsia* 1993; **34**: suppl 2, 14.
6. Bronen R. Epilepsy: The role of MR imaging. *Am J Roentgenol* 1992; **159**: 1165-1174.
7. Leppik I. *Contemporary Diagnosis and Management of the Patient with Epilepsy*. (Handbooks in Healthcare). 1st ed. Newtown, PA: 1993.
8. Theodore WH, Dorwart R, Holmes M, Porter RJ, Di Chiro G. Neuroimaging in refractory partial seizures: comparison of PET, CT and MRI. *Neurology* 1986; **36**: 750-759.