

# Ictal SPECT: A Service Evaluation

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## Introduction

Single photon emission computed tomography (SPECT) is a functional radionucleotide imaging study and involves the injection of a radioactive tracer whose distribution within the brain is directly related to blood flow. The procedure is used in pre-surgical evaluation in patients with medically-refractory epilepsy and, alongside electroen-cephalopgrahy (EEG) and neuroimaging studies, can provide a hypothesis pertaining to the area of epileptogenesis. Ictal SPECT imaging is achieved when the radioiso- tope is administered during an epileptic seizure; ideally, this should be within thirty seconds of seizure onset (Avery et al, 1999; Jae-Wook et al, 2010).

In the Department of Clinical Neurophysiology, Royal Hallamshire Hospital (RHH), Sheffield, video telemetry (VT) is performed to facilitate obtaining an ictal SPECT study. The patient is admitted to a dedicated side-room for three or five days and thirty-three EEG electrodes are applied, in accordance with the international 10/20 sys- tem of electrode placement. As per advice from the referring Consultant Neurologist, anti-epileptic drugs (AEDs) may be reduced or withdrawn and, if necessary, provoca- tion techniques will be performed to increase the probability of capturing a habitual event whilst the isotope is available. An intravenous line is inserted prior to the periods of isotope availability; its location is determined by witnessed clinical seizure semiology (where possible to is placed in a lesser affected upper limb. A qualified Clinical Technologist (Nuclear Medicine) is present to administer the radioisotope; Technetium-labelled HMPAO (stabilised) is consistently used and is available for four hours over two sequential days. EEG is recorded during periods of isotope availability and an experienced Clinical Physiologist (Neurophysiology) is present to monitor the patient for habitual clinical/electrographic seizure activity to ensure early and accurate administration of the radioactive tracer and subsequent interpretation of the ictal SPECT im- age.

## Aims & Objectives

- To evaluate the ictal SPECT service provided by RHH:
  - To quantify the number of successful ictal SPECTs
  - To quantify the number of concordant ictal SPECTs
  - To compare injection time achieved with published standards

## Method and Population

- Consecutive sampling between April 2000 and July 2016
- Included all adult and paediatric patients undergoing ictal SPECT
- Sample size:**
  - 74 studies; 68 patients
  - 34 males; 34 females
  - 49 adults; 25 paediatrics
- Age range:** 1-year-old to 71-years-old (mean: 27-years-old)

## Results

### EEG information:

- 9/74 (12.2%) had a normal ictal EEG
- 30/65 (40.5%) showed equivocal ictal EEG change
- 13/65 (20.0%) showed temporal ictal abnormalities
- 13/65 (20.0%) showed extra-temporal ictal abnormalities
- 9/65 (13.8%) showed diffuse or multi-focal ictal EEG change

### Imaging information (MRI )

- 27/74 (36.5) showed no clear abnormalities on neuroimaging
- 47/74 (36.5%) had a known lesion on neuroimaging
  - 20/47 showed mesial temporal sclerosis (MTS)
  - 4/47 (8.5%) showed focal cortical dysplasia (CD)
  - 6/47 (12.8%) showed >1 structural lesion
  - 17/47 (36.2%) were classified other, including: Sturge- Weber syndrome, cavernoma, infarction, glioma

### Ictal SPECT outcome:

- Ictal SPECT achieved in 42/74 (56.8%) of studies (Figure 1)
- Interictal SPECT performed in 31/74 (41.9%) of studies
- Abandoned in 1/74 (1.3%) due to lack of patient compliance
- 22/42 (52.4%) demonstrated unequivocal hyperperfusion (Figure 2)
  - 18/22 (81.8%) were concordant with pre-existing data
  - 4/22 (18.2%) showed discordant with pre-existing data
- 11/42 (26.2%) demonstrated equivocal changes (Figure 3)
- 3/42 (7.1%) were reported as normal and 6/42 (14.3%) unknown

## Summary

- The majority of successful ictal SPECTs allowed progression for surgi- cal treatment
- Our median injection time of 27 seconds is within the accepted 30 sec- ond guideline
- Ictal SPECT referrals to RHH continue to increase

### Indication for ictal SPECT:

- 34/74 (49.5%) to confirm focality of seizures
- 27/74 (36.5%) showed non-localising/non-lateralising ictal EEG change/clinical semiology
- 7/74 (9.5%) showed discordance between EEG and imaging
- 1/74 (1.4%) showed a normal ictal EEG with no overt/objective clinical semiology (aura only)
- 5/74 (6.8%) performed as diagnostic aid

### Activation techniques:

- 67/74 (90.5%) employed activation techniques, including: AED reduction or withdrawal, sleep- deprivation, sleep-wake reversal, music, praxis)
- 7/74 (9.5%) did not employ activation techniques

Figure 1: Injection time

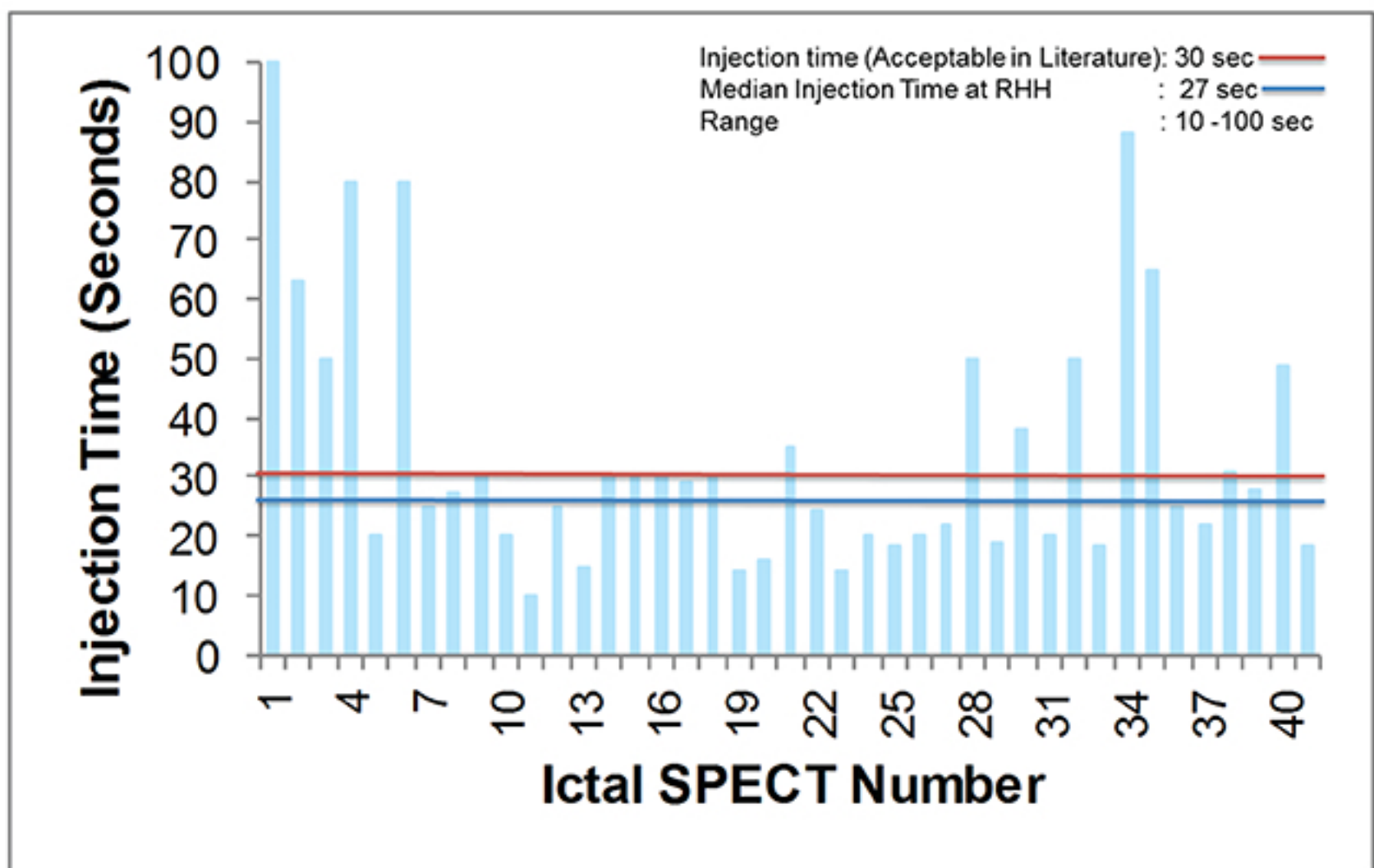


Figure 3: Equivocal ictal SPECT

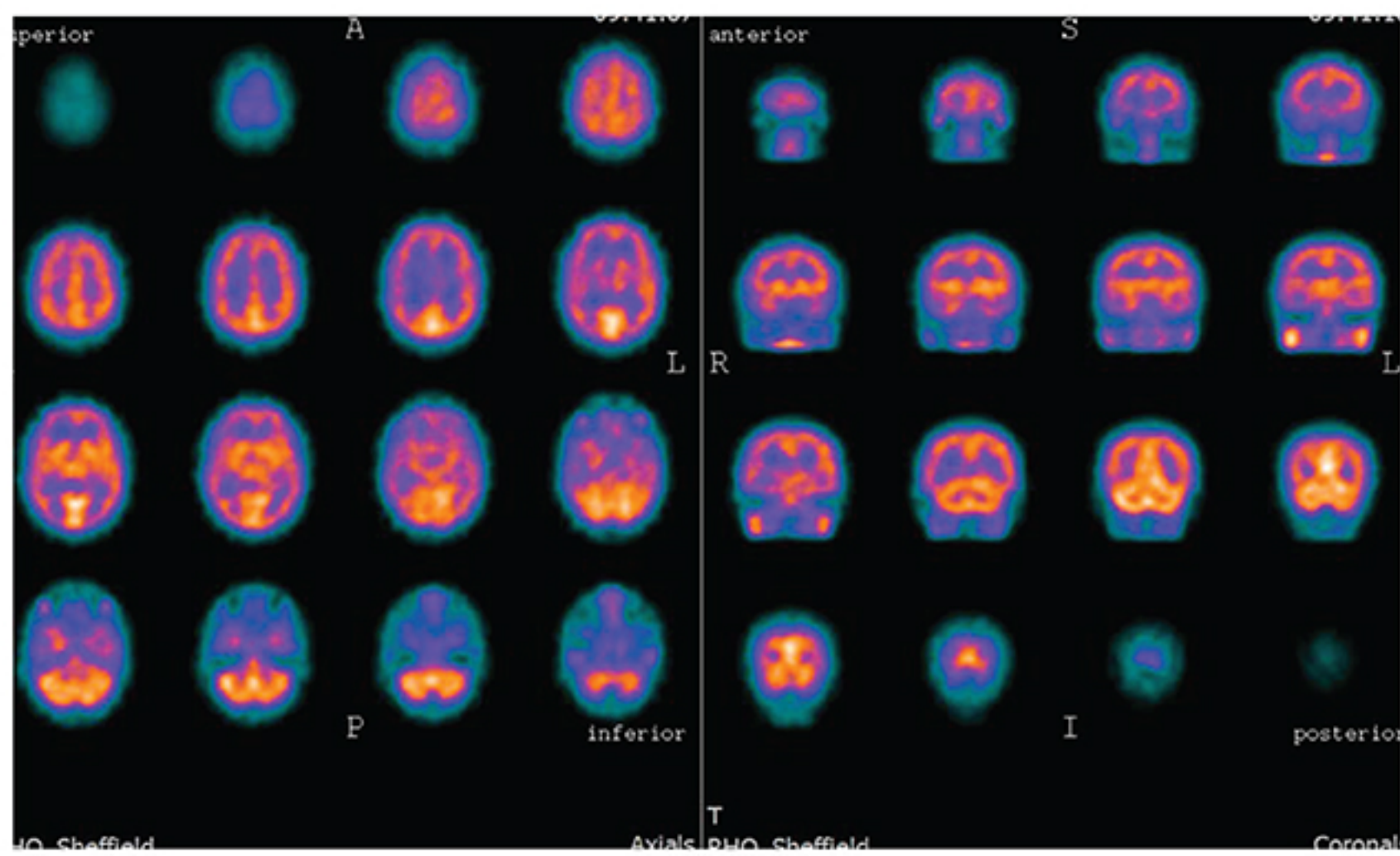


Figure 2: Unequivocal ictal SPECT

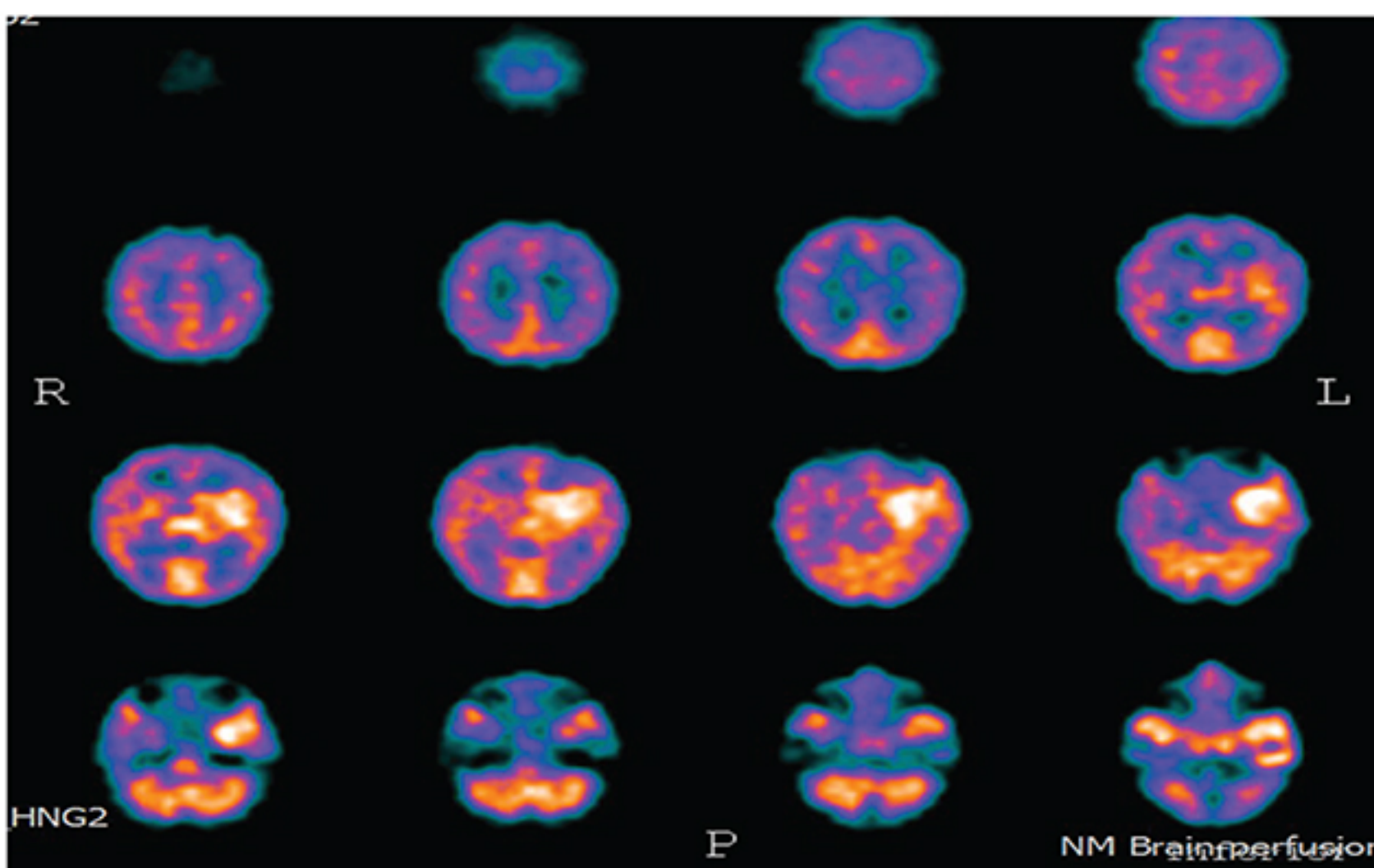
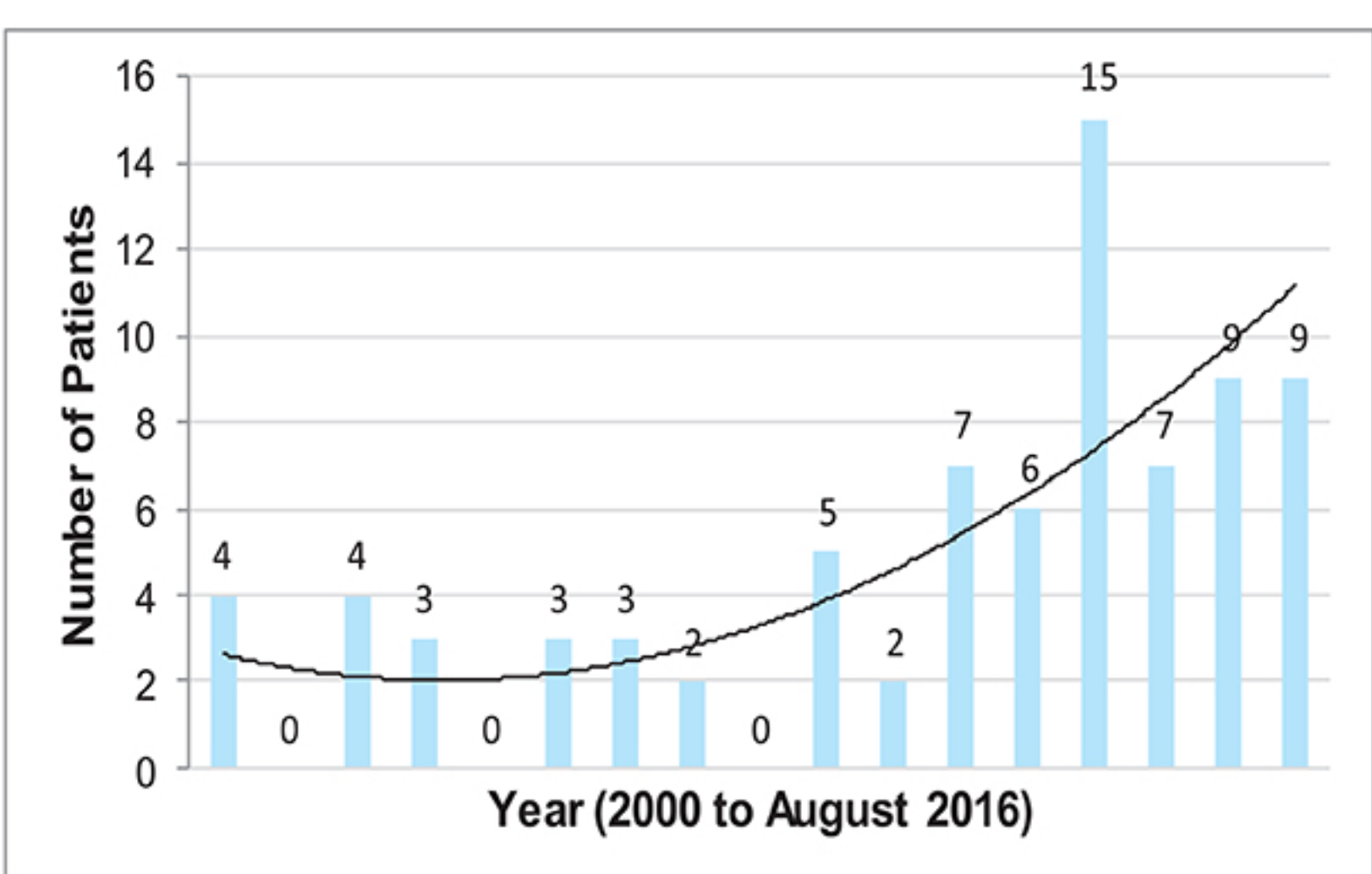


Figure 4: Ictal SPECT referrals



## References

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