PET Recommendation Report 13

A Quality Initiative of the Program in Evidence-Based Care (PEBC), Cancer Care Ontario (CCO)

The Utility of Positron Emission Tomography in Epilepsy

J.G. Burneo, R. Poon, S. Kellett, S. Houle, and O.C. Snead

Report Date: January 29, 2015

PET Recommendation Full Report 13 is comprised of 2 sections and is available on the CCO Web site (https://www.cancercare.on.ca)
Section 1: Recommendations
Section 2: Evidentiary Base

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The Utility of Positron Emission Tomography in Epilepsy: Recommendations

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RESEARCH QUESTION

What is the diagnostic accuracy and clinical utility of ^{18}F-fluorodeoxyglucose (^{18}F-FDG) positron emission tomography (PET) in the presurgical evaluation of adult and pediatric patients with medically intractable epilepsy?

TARGET POPULATION

These recommendations apply to adult and pediatric patients with medically intractable epilepsy being considered for surgery.

INTENDED USERS

- This recommendation report is intended to guide the Ontario PET Steering Committee in their decision making with respect to the development of indications for the use of PET in epilepsy.
- This recommendation report may also be useful to inform clinicians and patients who are seeking information about PET as a presurgical tool in epilepsy.

RECOMMENDATIONS AND KEY EVIDENCE

These recommendations are based on an evidentiary foundation consisting of a systematic review of the literature for the period from 1946 to September 2013.

^{18}F-FDG PET is recommended for the presurgical evaluation of adult and pediatric patients with medically intractable focal or partial epilepsy in the setting of a comprehensive epilepsy surgery program within a Regional Epilepsy Surgery Centre of Excellence.
Key Evidence: Across 13 primary studies, the proportion of adult patients in whom PET correctly localized a seizure focus and had a good surgical outcome ranged from 36% to 89% (1-13). This range improved to 71% to 89% when only considering patients with temporal lobe epilepsy. The corresponding results for pediatric patients were similar to that of the adult population (14,15). When PET results were combined with magnetic resonance imaging (MRI) or electroencephalogram (EEG), the sensitivity of detecting adult patients with good outcome increased by 8% to 23% (1-3,6). In children, the addition of PET to magnetoencephalography

(MEG) increased the sensitivity to 95% and decreased the number of false-negative tests for seizure-free outcome (15).

In surgical decision making, PET accurately predicted surgical candidacy in 68% of the patients and was shown to be the most sensitive test compared with EEG and MRI (16). Another study demonstrated a sensitivity of 60% and a positive predictive value (PPV) of 83% for PET in the identification of all surgical sites. The PPV of PET (94%) was higher for localization of temporal surgical sites (17). In children with intractable epilepsy, statistical parametric mapping (SPM) analysis of PET performed similarly well with a sensitivity of 71% in identifying areas of surgical resection (18).

In terms of impact on patient management, PET findings influenced the clinical decision in 53% to 71% of adult patients and 51% to 95% of pediatric patients (19-23).

Qualifying Statements:

- For localizing epileptic foci or guiding intracranial electrode placement as part of the presurgical evaluation in a Regional Epilepsy Surgery Centre of Excellence, patients with temporal lobe epilepsy may benefit more from PET than patients with extratemporal lobe epilepsy.
- The evidence is suggestive that localization is greater when PET is assessed using SPM and this method may be superior to visual interpretation for particular types of epilepsy. However, defining the exact group of patients for whom PET is likely to provide enhanced localization information based on SPM is beyond the scope of this report.

Due to insufficient evidence, a recommendation cannot be made for or against the use of ^{18}F-FDG PET in the detection of cortical malformations in patients with intractable infantile spasms when MRI or computed tomography (CT) fails to show structural abnormalities.

Key Evidence:

In the diagnostic evaluation of infantile spasms, PET uncovered unifocal or multifocal abnormalities in 95% of cryptogenic cases (22). However, confirmation of focal pathology was not available for those with multifocal abnormalities on PET, which accounted for the majority of children who were reclassified into the symptomatic category.

Qualifying Statements:

- Patients with intractable infantile spasms exhibiting focal metabolic abnormality on PET could be considered for surgery, provided that epileptogenicity of focal malformation is confirmed electrographically during the presurgical evaluation in a Regional Epilepsy Surgery Centre of Excellence. Surgery would not be considered based solely upon a focal area of hypometabolism on PET without other corroborating data.

Due to insufficient evidence, a recommendation cannot be made for or against the use of ^{18}F-FDG PET/MRI coregistration in the presurgical evaluation of patients with medically intractable epilepsy.

Key Evidence:

One study demonstrated that the addition of PET/MRI coregistration to the presurgical evaluation can enhance the detection of cortical dysplasia in patients with epilepsy (24).

However, these findings were based on a relatively small cohort studied retrospectively and provided no information as to whether this technique can be useful for assessing other etiologies in patients being considered for surgery. In another retrospective study involving children with refractory epilepsy, PET/MRI coregistration guided the second MRI interpretation from nonlesional to subtle-lesional in 42% of the cases (25). However, the PET-guided MRI interpretation was performed by only one neuroradiologist and patient outcomes based on these results were not reported.

FUTURE RESEARCH

There is a need for prospective studies to assess the use of PET/MRI and the advantages over standard PET studies.

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