Clinical Review Criteria

Single Photon Emission Computed Tomography (SPECT)

- Evaluation of Origin of Behavior Problems

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Criteria

For Medicare Members

<table>
<thead>
<tr>
<th>Source</th>
<th>Policy</th>
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<tbody>
<tr>
<td>CMS Coverage Manuals</td>
<td>None</td>
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<tr>
<td>Local Coverage Determinations (LCD)</td>
<td>None</td>
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<tr>
<td>Local Coverage Article</td>
<td>None</td>
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For Non-Medicare Members

Evaluation of Origin of Behavior Problems

There is insufficient evidence in the published medical literature to show that this service/therapy is as safe as standard services/therapies and/or provides better long-term outcomes than current standard services/therapies.

No review required for other indications.

The following information was used in the development of this document and is provided as background only. It is provided for historical purposes and does not necessarily reflect the most current published literature. When significant new articles are published that impact treatment option, KPWA will review as needed. This information is not to be used as coverage criteria. Please only refer to the criteria listed above for coverage determinations.

Background

Single Photon Emission Computed Tomography (SPECT) is a nuclear medicine technique that can be used to image almost any organ system. SPECT imaging is performed by acquiring multiple images (aka projections) with a gamma camera. A topographic reconstruction algorithm is then applied to the multiple two-dimensional projections, resulting in a three-dimensional dataset. To acquire the images, the gamma camera is rotated around the patient. The camera typically moves 3-6o each time until a 360 rotation is achieved. Each image takes approximately 15-20 seconds, for a total scanning time of approximately 15-20 minutes.

Brain imaging with SPECT is generally performed with the radiopharmaceutical hexamethylpropylene amine oxime (99mTC-HMPAO). 99mTC emits gamma rays that are detectable by a gamma camera. When attached to HMPAO, it can be taken up by brain tissue at a rate proportional to brain metabolism. Brain blood flow is highly correlated to local brain metabolism and energy use. Areas of the brain that are undergoing increased neuronal activity consume greater amounts of oxygen and energy and are perfused more, and areas of the brain that area less functionally active are perfused less. The SPECT image thus indirectly reflects cerebral metabolism. Patients undergoing brain SPECT are exposed to approximately 2-8 mSv of radioactivity, a level comparable to a CT scan. 99mTC-HMPAO SPECT brain scanning provides similar information about local brain function to FDG PET scans and functional MRI. Although PET has a higher resolution, the SPECT equipment is less expensive and may be more widely available. While MRI and PET are limited to hospitals due to their cost, SPECT equipment can be installed in physicians’ offices (Overmeyer & Taylor, 2001).
A report contracted by the American Psychiatric Association (APA) in 2005 concluded that SPECT is useful for research on psychiatric disorders, and for diagnosing cerebral trauma, seizure disorders and brain tumors for which there are detectible patterns of perfusion abnormalities. However, the authors found insufficient evidence to support the use of SPECT for the diagnosis and treatment of psychiatric disorders in the pediatric population. The APA report stated that there is a lack of evidence linking a particular structural or functional brain abnormality to a single psychiatric disorder. In addition, the authors cautioned that the long-terms effects of using the radioactive nucleotides associated with SPECT imaging in children and adolescents are not known.

A group of SPECT practitioners have criticized the APA report as being flawed and misleading (Wu et al, unpublished manuscript). They counter the APA claim that SPECT cannot yet diagnose psychiatric illness with the statement that clinicians do not rely on SPECT to make psychiatric diagnoses. Instead, SPECT practitioners use brain imaging as another source of data, along with clinical presentation, to help them make informed decisions about diagnosis. They also state that it is unfair to single out the possible danger associated with radioactive nucleotides used with SPECT imaging since children are treated with other nuclear medicine procedures such as studies for cardiovascular, cerebrovascular and orthopedic disease. They report that the average radiation exposure for one SPECT scan is similar to the exposure from a bone scan, brain CT scan or abdominal x-ray.

Medical Technology Assessment Committee (MTAC)
Single Photon Emission Computed Tomography
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Evidence Conclusion: In order to demonstrate that SPECT brain imaging is able to accurately diagnose behavior problems, there needs to be sufficient evidence that particular SPECT findings correlate with specific behavioral conditions, and that SPECT is sensitive and specific at diagnosing these conditions compared to a gold standard diagnostic tool. Most of the published studies on the first topic, SPECT findings associated with a clinical behavior problem are too small to produce reliable estimates. The largest study was by Amen and colleagues (1997). They compared SPECT scans of children with and without ADHD both at rest and while performing an intellectual stress task. The study found significantly decreased prefrontal activity during the intellectual stress activity in the ADHD group, but not the non-ADHD group. The Amen study is inconclusive due to the small sample size and lack of adjustment for confounding variables. Moreover, since only 65% of the participants with ADHD had decreased prefrontal activity during intellectual stress, it is not clear how the SPECT information would be used to help diagnose ADHD. In addition, Dr. Amen has a private clinic that performs SPECT which may bias the study's methods and conclusions. Gustafsson and colleagues performed a variety of tests on 28 children with ADHD, including brain SPECT and EEG. The investigators did not find a significant association between EEG and SPECT findings. They found several statistically significant correlations between regional cerebral blood flow detected by SPECT and several instruments, particularly the number of Minor Physical Abnormalities (MPA). The vast majority of statistical comparisons were not statistically significant, and since such a large number of comparisons were performed at p<0.05, some significant findings would be expected by chance alone. No empirical evidence was identified on the effectiveness of SPECT brain imaging to diagnose behavior problems or assist clinicians in making a diagnosis, and insufficient evidence on the safety of brain SPECT in the pediatric population.

Articles: Objective 1a: The ideal study design is a comparison of brain function or structure as assessed by SPECT among individuals with and without behavioral problems. Methodological features include sufficient sample size, appropriate selection of controls, matching or controlling for confounding variables, objective confirmation of diagnosis and appropriate statistical analysis. Several studies were identified that compared brain activity using SPECT among children with ADHD and healthy controls. The studies were generally limited by small sample sizes. Most included 20 or fewer children with ADHD and 7 or fewer controls. The largest study (n=54 ADHD, n=18 non-ADHD) was conducted by a prominent SPECT practitioner (Dr. Amen)—this study was critically appraised. Objective 1b: The ideal study of diagnostic accuracy would report the sensitivity and specificity of SPECT imaging and include an independent blinded comparison to a “gold standard” diagnosis. No studies that met the above criteria were identified. Only one study compared SPECT findings to another imaging technique, EEG (Gustafsson et al., 2000) and this study was critically appraised.

Objective 2: A strong study would compare the accuracy of the diagnosis made with and without information from SPECT imaging, with the diagnosis confirmed by an objective expert such as experienced psychiatrist blinded to diagnosis. No relevant studies were identified. Objective 3: No studies were identified on the long-term safety of SPECT brain imaging in children. The studies that were critically appraised were: Amen DG, Carmichael BD. High-resolution brain SPECT imaging in ADHD. Ann Clin Psychiatry 1997; 9: 81-86. See Evidence Table. Gustafsson P, Thernlund G, Ryding E et al. Associations between cerebral blood flow...
measured by single photon emission computed tomography (SPECT), electro-encephalogram (EEG), behavior symptoms, cognition and neurological soft signs in children with attention-deficit hyperactivity disorder (ADHD). Acta Pediatr 2000; 89: 830-835. See Evidence Table.

The use of Single Photon Emission Computed Tomography in the evaluation of origin of behavior problems does not meet the Kaiser Permanente Medical Technology Assessment Criteria.