Name of Blue Advantage Policy:  
Magnetic Resonance Neurography

Policy #: 177       Latest Review Date: September 2018  
Category: Radiology       Policy Grade: C

Background:  
Blue Advantage medical policy does not conflict with Local Coverage Determinations (LCDs),  
Local Medical Review Policies (LMRPs) or National Coverage Determinations (NCDs) or with  
coverage provisions in Medicare manuals, instructions or operational policy letters. In order to  
be covered by Blue Advantage the service shall be reasonable and necessary under Title XVIII of  
the Social Security Act, Section 1862(a)(1)(A). The service is considered reasonable and  
necessary if it is determined that the service is:

1. Safe and effective;
2. Not experimental or investigational*;
3. Appropriate, including duration and frequency that is considered appropriate for the  
   service, in terms of whether it is:
   • Furnished in accordance with accepted standards of medical practice for the  
     diagnosis or treatment of the patient’s condition or to improve the function of a  
     malformed body member;
   • Furnished in a setting appropriate to the patient’s medical needs and condition;
   • Ordered and furnished by qualified personnel;
   • One that meets, but does not exceed, the patient’s medical need; and
   • At least as beneficial as an existing and available medically appropriate alternative.

*Routine costs of qualifying clinical trial services with dates of service on or after September 19,  
2000 which meet the requirements of the Clinical Trials NCD are considered reasonable and  
necessary by Medicare. Providers should bill Original Medicare for covered services that are  
related to clinical trials that meet Medicare requirements (Refer to Medicare National Coverage  
Determinations Manual, Chapter 1, Section 310 and Medicare Claims Processing Manual  
Chapter 32, Sections 69.0-69.11).
**Description of Procedure or Service:**
Magnetic resonance neurography (MRN) is a novel imaging technique recently developed for direct imaging of spinal and peripheral nerves. Modifications are made to standard MRI technology using special software and hardware upgrades that enable direct high-resolution longitudinal and cross-sectional images of peripheral nerves such that the morphology of the nerve can be visualized. MRN has been studied to supplement diagnostic evaluations by electromyography (EMG) and nerve conduction studies (NCS) in patients with suspected peripheral nerve tumors, traumatic injury, post-irradiation neuritis, chronic compression, and pain syndromes where an anatomic lesion is suspected.

**Policy:**
**Effective for dates of service on or after August 23, 2011:**
Blue Advantage will treat magnetic resonance neurography as a non-covered benefit and as investigational.

*Blue Advantage does not approve or deny procedures, services, testing, or equipment for our members. Our decisions concern coverage only. The decision of whether or not to have a certain test, treatment or procedure is one made between the physician and his/her patient. Blue Advantage administers benefits based on the members' contract and medical policies. Physicians should always exercise their best medical judgment in providing the care they feel is most appropriate for their patients. Needed care should not be delayed or refused because of a coverage determination.*

**Key Points:**
The most recent literature review was performed through August 2018.

Evidence reviews assess the clinical evidence to determine whether the use of a technology improves the net health outcome. Broadly defined, health outcomes are length of life, quality of life, and ability to function including benefits and harms. Every clinical condition has specific outcomes that are important to patients and to managing the course of that condition. Validated outcome measures are necessary to ascertain whether a condition improves or worsens; and whether the magnitude of that change is clinically significant. The net health outcome is a balance of benefits and harms.

To assess whether the evidence is sufficient to draw conclusions about the net health outcome of a technology, two domains are examined: the relevance and the quality and credibility. To be relevant, studies must represent one or more intended clinical use of the technology in the intended population and compare an effective and appropriate alternative at a comparable intensity. For some conditions, the alternative will be supportive care or surveillance. The quality and credibility of the evidence depend on study design and conduct, minimizing bias and confounding that can generate incorrect findings. The randomized controlled trial is preferred to assess efficacy; however, in some circumstances, nonrandomized studies may be adequate.
Randomized controlled trials are rarely large enough or long enough to capture less common adverse events and long-term effects. Other types of studies can be used for these purposes and to assess generalizability to broader clinical populations and settings of clinical practice.

Available published studies lack direct and timely comparisons of magnetic resonance neurography (MRN) to examinations/other imaging procedures, with established reference standards; the sensitivity, specificity, positive and negative predictive values remain unknown. Due to the lack of well-designed controlled trials, the accuracy and clinical utility of MRN in peripheral nerve disorders has not been established. It remains unclear if MRN would be utilized as a single imaging tool or in conjunction with other imaging techniques including other MR imaging techniques. Additionally, the accuracy and clinical utility of MRN will vary by diagnosis, and thus remains unknown.

**Registry Studies**

Filler et al (2005) prospectively evaluated 239 consecutive patients experiencing leg pain in the distribution of the sciatic nerve and in whom a diagnosis could not be established or in whom lumbar spine surgery did not relieve pain were evaluated. Results of these imaging evaluations combined with those of physical examinations were used as indications either for fluoroscopically guided diagnostic spinal injections or for MR imaging–guided injections of muscle or nerve near lumbar soft tissues or in the pelvis. Patients in whom physical examination findings and medical history were consistent with piriformis syndrome and in whom magnetic resonance neurography (MRN) did not rule out piriformis syndrome were considered to have probable piriformis syndrome and were referred for injection. The reference standard for a diagnosis of piriformis syndrome was if the individual’s treatment was successful. The authors noted that when piriformis muscle asymmetry alone is used as a criterion to identify individuals with piriformis syndrome, criterion sensitivity and specificity are 46% and 64%, respectively. If unilateral sciatic nerve hyperintensity at the level of the sciatic notch is added as a criterion to identify individuals with piriformis syndrome, criteria sensitivity and specificity are 64% and 93%, respectively.

In a prospective observational study of patients with sciatica, Zhang et al (2009) investigated the effectiveness of 3-D high-spatial resolution diffusion-weighted magnetic resonance neurography (MRN) based on steady state free precession (3-D diffusion-weighted steady-state free precession [DW-SSFP]) in the diagnosis of sciatica. The 3-D DW-SSFP sequence was performed on 137 patients with sciatica and 32 patients in control group. The post-processing techniques were used to generate images of lumbo-sacral plexus and sciatic nerve, and the images acquired were assessed based on the presence or absence of nerve abnormality. The certainty of identifying the lumbo-sacral plexus and main branches from all cases was determined in each of the reconstruction planes for each case individually and assessed by using a 3-score scale. The sciatic nerve and its main branches were differentiated and a clear picture was obtained in all subjects. Compared with the control group, the presence of nerve root compression or increased T2 signal intensity changes can be observed in all patients. The mean score of certainty of identifying the sciatic nerve and main branches was 1.76 +/- 0.4, which indicates that the sciatic nerve and main branches can be identified with certainty. The authors concluded that the 3-D DW-SSFP MRN with high spatial and sufficient contrast is an excellent
technique to define the nature of sciatica and assists in prognostication and possibly in management.

Du et al (2010) retrospectively compared magnetic resonance neurography (MRN) and NCS/EMG in 91 patients with spinal and/or peripheral nerve disorders. MRN was obtained a median of twelve months after the onset of symptoms. The median interval from onset of symptoms to NCS/EMG was eight months. The most common diagnoses were radiculopathy (in 31% of patients), peripheral neuropathy (19%), and brachial plexopathy (in 12%). Radiculopathies were evaluated most frequently in the cervical and lumbar regions (58 and 38%, respectively). Peripheral mononeuropathies most commonly involved the sciatic nerve (in 61% of patients). Compared to NCS/EMG, MRN was found to give the same information in 29 patients (32%), additional diagnostic information in 41 (45%), less information in 15 (17%), and a different diagnosis in 6 (7%). The authors noted that cases in which MRN provides more diagnostic information than NCS/EMG are important in determining when MRNs can be expected to be helpful. For example, MRN was helpful when traditional MRI and NCS/EMG results was inconclusive; but not helpful if the time from onset of symptoms was > one year.

Hilgenfeld et al (2017) examined if high-resolution brachial plexus (BP) MRN is capable of distinguishing patients with compressive neuropathy or non-compressive plexopathy from age- and sex-matched controls, discriminating between patients with compressive neuropathy and non-compressive plexopathy, and detecting spatial lesion patterns suggesting somatotopic organization of the BP. A total of 36 patients (50.9 ± 12.7 years) with clinical symptoms, nerve conduction studies, and needle EMG findings suggestive of BP and 36 control subjects matched for age and sex (50.8 ± 12.6 years) underwent high-resolution MRN of the BP. Lesion determination and localization was performed by 2 blinded neuro-radiologists at the anatomical levels of the plexus trunks and cords. By applying defined criteria of structural plexus lesions on high-resolution MRN, all patients were correctly rated as affected, whereas 34 of 36 controls were correctly rated as unaffected by independent and blinded reading from 2 neuro-radiologists with overall good to excellent inter-rater reliability. In all cases, plexopathies with a compressive etiology (n = 12) were correctly distinguished from non-compressive plexopathies with inflammatory origin (n = 24). Patho-anatomical contiguity of lesion from trunk into cord level allowed recognition of distinct somato-topical patterns of fascicular involvement, which correlated closely with the spatial distribution of clinical symptoms and electrophysiological data.

The authors concluded that BP MRN was highly accurate for differentiating patients with symptomatic plexopathy from healthy controls and for distinguishing patients with compressive neuropathy and non-compressive plexopathy. Furthermore, BP MRN revealed evidence for somatotopic organization of the BP. Therefore, as an addition to functional information of electro-diagnostic studies, anatomical information gained by BP MRN may help to improve the efficiency and accuracy of patient care. These preliminary findings need to be validated by well-designed studies.

Kronlage et al (2018) established normal values and identified demographic determinants of quantitative biomarkers in MRN. A total of 60 healthy individuals (5 men and 5 women of every decade between 20 and 80 years) were examined according to a standardized MRN protocol at
3 T, including multi-echo T2 relaxometry. Nerve CSA, transverse relaxation time (T2), and PSD were assessed for the sciatic, tibial, median, ulnar, and radial nerves. Correlation with demographic variables, such as height, weight, body mass index (BMI), and age was expressed by Pearson coefficients and t-tests were used to compare MRN biomarkers between men and women with and without normalization to body weight and BMI by linear regression. The average nerve CSA correlated moderately with height ($r = 0.28$, $p = 0.04$), weight ($r = 0.40$, $p = 0.002$), and BMI ($r = 0.35$, $p = 0.008$), but not with age ($r = 0.23$, $p = 0.09$). While T2 did not correlate with demographic parameters, PSD was strongly inversely associated with BMI ($r = -0.64$, $p < 0.001$) and weight ($r = -0.557$, $p < 0.001$). Sex-dependent differences in imaging marker values were found for CSA but became negligible after normalization to body weight. The authors concluded that quantitative biomarkers of MRN co-varied with demographic variables. As particularly important determinants, these researchers identified body weight for nerve CSA and BMI for PSD. They stated that the presented normal values and demographic determinants may assist investigations into the potential of MRN biomarkers in further disease-specific studies.

**Summary of Evidence**

Although current evidence supports MRN as a promising technique, the outcome data which would determine the efficacy of this technology is limited to studies involving a small number of patients, making it premature to offer conclusions regarding its effectiveness for the general population. Additionally, large-scale, well-conducted, controlled studies with this approach are warranted to determine its efficacy in imaging neurofibromas and distinguishing benign from malignant lesions.

Currently, the sensitivity, specificity, as well as positive predictive value (PPV) and negative predictive value (NPV) of MRN in the diagnosis and management of patients with peripheral nerve disorders remain unclear. Thus, the accuracy and clinical value of Magnetic resonance neurography has yet to be established.

**Key Words:**
Magnetic resonance neurography, MRN, Magnetic resonance neurogram

**Approved by Governing Bodies:**
Not applicable

**Benefit Application:**
Coverage is subject to member’s specific benefits. Group specific policy will supersede this policy when applicable.
Coding:

CPT Codes:

76498 Unlisted magnetic resonance procedure (e.g., diagnostic, interventional)
64999 Unlisted Procedure, Nervous System

References:


Policy History:
Adopted for Blue Advantage, June 2011
Available for comment July 6 through August 22, 2011
Medical Policy Group, July 2015
Medical Policy Group, September 2018 (3) Updates to Key Points and References. No changes to policy statement or intent.
This medical policy is not an authorization, certification, explanation of benefits, or a contract. Eligibility and benefits are determined on a case-by-case basis according to the terms of the member’s plan in effect as of the date services are rendered. All medical policies are based on (i) research of current medical literature and (ii) review of common medical practices in the treatment and diagnosis of disease as of the date hereof. Physicians and other providers are solely responsible for all aspects of medical care and treatment, including the type, quality, and levels of care and treatment.

This policy is intended to be used for adjudication of claims (including pre-admission certification, pre-determinations, and pre-procedure review) in Blue Cross and Blue Shield’s administration of plan contracts.