ORIGINALARTICLE

Minimum Standards for Electromyography in Canada: A Statement of the Canadian Society of Clinical Neurophysiologists

Prepared by C.F. Bolton, T.J. Benstead, F. Grand'Maison, G.S. Tardif and L.E. Weston on behalf of The Canadian Society of Clinical Neurophysiologists

ABSTRACT: ***Background:*** Electromyography (EMG) is a widely used diagnostic technique for disorders of the nervous system. The Canadian Society of Clinical Neurophysiologists (CSCN) promotes the education, evaluation and standards of EMG in Canada. A statement of practice standards was needed to clarify the position of the CSCN on several issues relevant to the practice of EMG. ***Methods and Results:*** A subcommittee of the CSCN reviewed current patterns of practice and established guidelines for review by the CSCN. The guidelines developed by the subcommittee were reviewed by the CSCN and adopted as recommendations for EMG practice. The subcommittee was charged with formulation of a document for publication. ***Conclusions:*** This document deals with minimum standards for electromyographer education, laboratory operation, equipment and a variety of special circumstances relevant to the practice of EMG. The standards can be adopted by EMG laboratories to guide quality assurance.

RÉSUMÉ: Standards minimums pour l'électromyographie au Canada: Recommandations de la Société canadienne de neurophysiologie clinique. ***Introduction:*** L'électromyographie est une technique diagnostique largement utilisée dans l'investigation des pathologies du système nerveux. La Société canadienne de neurophysiologie clinique (SCNC) fait la promotion de l'éducation, de l'évaluation et des standards d'électromyographie au Canada. Des recommandations était nécessaire pour clarifier la position de la SCNC sur plusieurs sujets pertinents à la pratique de l'électromyographie. ***Méthodes et Résultats:*** Un sous-comité de la SCNC a révisé les modalités de pratique courantes et a établi des lignes directrices que la SCNC a révisées et adoptées, et elle en fait la promotion pour la pratique de l'électromyographie. Le sous-comité était chargé de formuler un document pour publication. ***Conclusions:*** Ce document traite des standards minimums pour l'enseignement de l'électromyographie, le fonctionnement d'un laboratoire, l'équipement ainsi que d'autres sujets pertinents à la pratique de l'électromyographie. Les standards peuvent être adoptés par les laboratoires d'ÉMG comme guide d'assurance de qualité.

Can. J. Neurol. Sci. 2000; 27: 288-291

The Canadian Society of Clinical Neurophysiologists (CSCN) has been operating in Canada since 1957, with the aim of maintaining high professional standards in the two disciplines of Electromyography and Electroencephalography. The electromyography (EMG) section of CSCN established an examination for EMG technologists in 1980 and, in conjunction with the Association of Electromyography Technologists of Canada (AETC), has run these examinations on a yearly basis, establishing a benchmark for competence in electromyographic technical procedures across Canada. In 1992, the first Canadian examination for electromyographers was held and is now held on a yearly basis, advancing the process of ensuring competency in physician electromyographers across Canada.

The establishment of minimum standards of practice and other professional matters related to EMG laboratories is, to a considerable extent, governed by the various provinces in Canada. With increasing emphasis on quality control and cost-

From the Department of Clinical Neurological Sciences, University of Western Ontario, London ON (CFB), Division of Neurology, Dalhousie University, Halifax NS (TJB), Service de Neurologie, Hôpital Charles Le Moyne, Tarcheseau, Greenfield Park, Quebec (FG-M), Division of Physical Medicine and Rehabilitation, University of Toronto, ON (GST) and Neurology, The Moncton Hospital, Moncton NB(LEW) Canada

RECEIVED JUNE 5, 2000. ACCEPTEDIN FINALFORM SEPTEMBER 1, 2000.

Reprint requests to: Canadian Society of Clinical Neurophysiologists, Secretariat Office, Suite 709, 7015 Macleod Trail SW, Calgary, Alberta T2H 2K6 Canada.

effectiveness, the CSCN realized that it would be worthwhile to recommend minimum standards for EMG in Canada. This would provide a firm basis for acceptance of these standards at the provincial level.

Clinical electromyography

The term "electromyography" was first used more than 40 years ago to indicate the recording of electrical activity in muscle through the insertion of a needle electrode. It has now come to represent a wide variety of methods of stimulating and recording from the nervous system. The techniques used include standard motor and sensory nerve conduction studies, repetitive nerve stimulation to detect a defect in neuromuscular transmission, needle EMG of skeletal muscle, single fiber and macro EMG, measurements of F and H wave responses, blink reflexes, tests of the autonomic nervous system – the cardiac R-R interval and sympathetic skin response, somatosensory evoked potentials and magnetic stimulation of the central and peripheral nervous systems. These various procedures can document the function of the pyramidal tracts and sensory tracts of the central nervous system, the nerve roots and peripheral nerves, the neuromuscular junction and the muscle. By these methods, a wide variety of diseases of both the central and the peripheral nervous system can be investigated, the results often being a major step in determining the correct diagnosis, in prescribing treatment and in establishing a prognosis. Moreover, the tests provide objective measurements of nervous system function, which can be utilized in assessing various modes of treatment. The tests are carried out usually with minimum discomfort, in children and adults, premature infants, out-patients and in-patients from general wards, critical care units and operating rooms. So important have these tests become that they are an essential part of investigation of almost any "neuromuscular" disturbance of the nervous system.

Recommendations for minimum standards

A subcommittee of the CSCN evaluated educational and practice patterns for EMG in Canada. The subcommittee was made up of Neurology and Physical Medicine and Rehabilitation members of the CSCN with representation from academic and community-based practices. The subcommittee consulted electromyographers in various regions of Canada. The results of the subcommittee's work were presented for discussion and endorsed at the annual meeting of the CSCN. The subcommittee was charged with preparation of the minimum standards document for publication.

The Electromyographer

The laboratory will be under the direction of a physician who has passed either the Canadian Examination in Electromyography, the Examination of the American Board of Electrodiagnostic Medicine or an equivalent assessment process. Full membership in the CSCN necessitates an assessment of training and experience and is one method of assessing equivalent competence of electromyographers who began practice prior to when the examinations became available. In order to qualify for the Canadian Examination in Electromyography, the electromyographer must have passed the examination of the Royal College of Physicians and Surgeons of Canada, the College of Physicians of Québec or their equivalent, in the specialties of Neurology, Physical Medicine and Rehabilitation, or Neurosurgery. The Canadian exam requires training for at least six months in a laboratory directed by a member of the CSCN, EMG section (or equivalent standard in other countries). Training must be in an academic centre with a residency training program in Neurology or Physical Medicine and Rehabilitation.

The Electromyography Technologist

The technologist will have had the appropriate training, designated by the AETC, will have passed the Canadian examination, or will be in training for the examination. In Québec, technologists will have obtained a Diplôme en Études Collégiales in medical electrophysiology. Details regarding current training requirements for EMG technologists in Canada can be obtained in detail from the AETC.

The Physical Facilities

The laboratory, if located within an institution, must have the full approval of that institution and abide by its bylaws. Wherever the laboratory is located, it will abide by the regulations that have been established by provincial authorities. This applies to the conduct of the laboratory and billing procedures. The structure of the laboratory must be such that it is conducive to the reception of patients for appropriate documentation, adequate taking of a history and physical examination, performance of the electromyographic techniques and the storing of various equipment used in the laboratory. There should be adequate reference and educational materials for personnel working in the laboratory.

Facilities should be available for prompt communication with referring doctors and patients and the generation of a final report to the referring doctor.

The Electromyography Equipment

The equipment used must meet the requirements of the Canadian Standards Association, in regard to safety of electrical, mechanical and structural components and safety of the environment – radiation, toxins, and inflammable substances. The classification of maximum current leakage should be Class 1, type BF (maximum 500 µamps). Maintenance should be regularly carried out as required by the manufacturer. Equipment should be of a type that can successfully perform, at a minimum, motor and sensory nerve conduction studies, repetitive nerve stimulation to test defects of neuromuscular transmission, and needle EMG of muscle. In many laboratories, particularly those associated with tertiary care centres, equipment should be more sophisticated and capable of performing techniques such as somatosensory evoked potentials, single fiber EMG, and others. A biomedical technologist, or the services of the company manufacturing the EMG equipment, should be immediately available for consultation and repair of breakdown in equipment.

There should be a method of permanently storing, electronically or on paper, certain waveforms and all the numerical data. The final report and the interpretation of the data by the electromyographer should also be stored for future reference.

https://doi.org/10.1017/S0317167100001013 Published online by Cambridge University Press

Normative Data

Accurate normative data is an essential requirement for all electrodiagnostic laboratories. Ideally, every laboratory would have the facilities to establish their own normative database but this is impractical for all but very large centres. However, literature controls are available for most studies performed and these can be utilized if there is close adherence to the methods employed to obtain the normal values. The literature methods must sufficiently describe techniques used to allow reproduction of the test. The age range of subjects used to obtain normal values should cover the age range of patients being studied. The methods described must note that limb temperature was monitored and the diagnostic lab must precisely follow these temperature limits. Failure to control for temperature effects during electrodiagnostic studies is a major source of error. Limb temperatures need to be monitored and warmed to standard temperatures if cool. Recorded limb temperatures should be incorporated into the final report. Quality assurance in the lab must include an assessment of the normative database.

Evaluation Protocol in EMG Laboratories

It should be understood by referring physicians and the patient that testing in the EMG laboratory is designed to assist in establishing the correct diagnosis and that this requires taking a preliminary history and performing a physical examination appropriate to assessing the neuromuscular complaints before the actual tests are performed. Pertinent data from the referring physician is essential. This initial clinical assessment is of crucial importance in deciding which electrophysiological tests are to be utilized and must be performed by a physician with specialized knowledge of neuromuscular diseases. Electromyography is an extension of the clinical examination. Once the EMG is underway, the testing protocol will be adjusted to accommodate the results of preliminary testing. The interactive nature of the EMG evaluation requires the presence of an experienced consultant during the testing procedure.

All aspects of the functioning of the laboratory must be under the direct supervision of the EMG physician. However, the various procedures may be delegated, under supervision, to physicians training in the laboratory, depending upon their experience and competence. The electromyographer must be present in the laboratory or immediately nearby when physician trainees are performing tests. The electromyographer needs to be available to check or repeat studies by trainees if warranted. Nerve conduction studies and needle EMG can be performed by electromyographer trainees but the results must be reviewed by the electromyographer before a final interpretation is made. The patient should not leave the laboratory until the electromyographer has reviewed the final results. The electromyographer will be entirely responsible for the contents of the final report to the referring physician. Electromyography technologists can perform nerve conduction studies with an electromyographer readily available for consultation but cannot perform needle EMG.

From the time the patient enters the laboratory, there should be effective communication with the patient, who should be informed of the nature and reason for the various tests. No tests will be performed without the verbal consent of the patient except in comatose, pediatric and incompetent patients who will require proxy consent.

During physical examination and performance of certain tests, it may be necessary to disrobe the patient to varying degrees. This should always be performed to maintain the patient's modesty as much as possible.

In most instances, the procedures are of minimal discomfort and do not require sedative or analgesic medication. However, should this be required in adults, the patient must be escorted home by a responsible adult. For children requiring sedation, a registered nurse or physician must accompany the child until sedation has ended.

The Report

The report must include:

1. identification of the patient;
2. statement of the problem and the indication for the study;
3. tabulation of the values obtained during the test;
4. statement of normality or abnormality of these findings;
5. clinical correlation and diagnostic conclusions;
6. signature of the electromyographer.

Final Explanations to the Patient

Many patients will want to know the results of their tests and these will be explained to them by the electromyographer, keeping in mind final decisions regarding management are the province of the referring physician.

AVOIDANCE OF RISKS IN THE ELECTROMYOGRAPHY LABORATORY

a) Bleeding Tendencies

The risk of significant bleeding during EMG is exceptionally rare and there are no clear guidelines based on evidence of when bleeding is of sufficient risk to require avoidance of needle studies. However, it is best not to perform needle EMG in patients who have a platelet count less than 50,000 per cubic mm., an international normalized ratio greater than 3 and, when Heparin is administered, a partial thromboplastin time greater than two times control values. This procedure should also be avoided in patients who have hemophilia or other disorders of coagulation, unless clotting functions have been appropriately corrected.

b) Transmissible Diseases

There is risk of transmission of disease, for Jakob-Creutzfeldt disease, hepatitis and human immunodeficiency virus (HIV), particularly through the procedure of needle EMG. Single use disposable needles are recommended whenever possible. If needles are to be re-used, risk of HIVinfection can be eliminated by effective chemical treatment. Needles must be cleaned to remove blood adhering to the needle prior to sterilization or disinfection. Treatment of the needle within one minute with 0.5% sodium hypochlorite, 70% alcohol or 0.5% nonidet-P40 will kill the HIV virus. The needle manufacturer's recommendations regarding disinfecting solutions should be consulted to ensure the recording quality of the needle would not be damaged by the solution used. Autoclaving should then be done to kill bacterial and other microbial agents including hepatitis B virus. If the patient is suspected of having Jakob-Creutzfeldt disease, only single use disposable needles should be used.

The electromyographer and other staff handling needles are at

https://doi.org/10.1017/S0317167100001013 Published online by Cambridge University Press

risk of a transmissible disease by accidental puncturing of the skin after the needle has been withdrawn from the patient's muscle and is contaminated by blood. Every patient should be regarded as potentially infected by a transmissible disease. Thus, universal precautions should be adhered to in all patients.

The EMG laboratory should have their infection control techniques reviewed by the institution affiliated with the laboratory and in the case of private laboratories, by the provincial College of Physicians and Surgeons.

c) Cardiac Pacemakers

Electrophysiologic studies can be performed in patients who have implanted cardiac pacemakers. However, in studying such patients there should be effective grounding and it is unwise to stimulate the brachial plexus ipsilateral to the pacemaker implantation site. Nerve conduction studies are not recommended in any patient with an external conductive lead terminating in, or near to, the heart; i.e. external cardiac pacemakers.

d) Studies in the Critical Care Unit and Operating Rooms

Theoretically, electrical stimulation near an intravascular catheter carries a risk of cardiac arrhythmia or electrical injury to the heart. However, no such injuries have occurred in over 300 patients studied with phrenic nerve conduction studies in the critical care unit where intravascular catheters are usually present (personal experience, CFB). Nevertheless, if such studies are required, proper grounding is necessary and electrical stimuli should not be applied in the presence of fluid leakage. The ground should always be applied in the limb ipsilateral to the stimulation. If applied contralaterally, the electrical impulse may traverse the trunk and risk causing cardiac arrhythmia or arrest.

EMG machines and all electrical equipment attached to the patient during these procedures should be officially checked for potential hazards, as recommended by the Canadian Standards Association.

e) Chest Wall and Abdominal Musculature

When performing needle EMG in these areas, there is a very slight risk of puncturing the lung or other viscera. Knowledge of the local anatomy is, therefore, of great importance for those performing the test. Precaution is particularly important in children and young infants, where these viscera may be quite close to the skin surface. Needling near the chest wall may be of greater risk in patients who suffer chronic obstructive lung disease, particularly if such patients are on a ventilator. The procedure should be avoided in these patients but if it is necessary, the patient should be monitored for at least an hour afterwards to detect the development of pneumothorax.

SUMMARY

This statement of standards for EMG has been prepared by a subcommittee of the CSCN and has been adopted by the CSCN to guide their members. The standards would be appropriate for all EMG laboratories and can be used to guide quality assurance. As with all statements of standards it will require periodic review to remain appropriate in guiding the performance of this important procedure.

https://doi.org/10.1017/S0317167100001013 Published online by Cambridge University Press