—Report on Experiments and Clinical Cases—

Applying the Extensor Digitorum Reflex to Neurological Examination

Ming-Juan Zhang, Can-Zhan Zhu, Zong-ming Duan and Xiaolin Niu

Department of Cardiology, Second Affiliated Hospital, School of Medicine, Xi'an Jiao Tong University, China

Abstract

Aim: To determine the value of the extensor digitorum reflex in neurologic examination.

Methods: The extensor digitorum, biceps, and brachioradialis reflexes were elicited in 65 patients with hemiplegia and upper-limb paralysis and in a control group of 120 apparently healthy people. Reflexes were elicited by both conventional means and a new method for the extensor digitorum reflex. The sensitivity and specificity of the extensor digitorum reflex were compared with that of the conventional biceps and brachioradialis reflexes to evaluate the value of the extensor digitorum reflex for neurologic examination.

Results: The sensitivity of the extensor digitorum, biceps, and nrachioradialis reflexes were 93.65%, 90.48%, and 90.48%, respectively. The specificity of the extensor digitorum, biceps, and brachioradialis reflexes were 95.83%, 94.17%, and 93.33%, respectively. The diagnostic efficacies of the extensor digitorum, biceps, and brachioradialis reflexes were 95.08%, 92.90%, and 91.26%, respectively. There were no significant differences (p>0.05) in sensitivity, specificity, or accuracy among the extensor digitorum, biceps or brachioradialis reflexes in neurologic examination.

Conclusions: The extensor digitorum reflex is a sensitive and useful deep tendon reflex and is suitable for widespread use in neurological examination.
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Key words: extensor digitorum reflex, neurological examination

Introduction

Even with modern imaging techniques, such as computed tomography (CT) and magnetic resonance imaging (MRI), the neurologic examination remains a valuable diagnostic tool for the detection of intracranial lesions and nervous system disorders. The neurologic examination allows an astute clinician to pinpoint lesions in the nervous system, often with remarkable accuracy. During a careful neurologic examination, deep tendon reflexes can help the practitioner pinpoint lesions in the nervous system and their relationship to the motor system. They enable the practitioner to recognize a psychogenic malingering problem. Deep tendon reflexes also allow the detection of location abnormalities, and the ability to distinguish between upper and lower motor neuron lesions. These relationships are key to diagnosing the location and nature of intracranial lesions, which can then be confirmed by radiography, CT, or MRI. As a medical

Correspondence to Ming-Juan Zhang, MD, PhD, Department of Cardiology, Second Affiliated Hospital, School of Medicine, Xi'an Jiao Tong University, The Western Fifth Road No157#, Xi'an, Shaanxi Province, The Peoples' Republic of China
E-mail: zhangmingjuan@mail.xjtu.edu.cn
Journal Website (http://www.nms.ac.jp/jnms/)

Table 1 Clinical data and diagnosis of test subjects

	Patients	Controls
Diagnosis		
Cerebral hemorrhage	46	—
Cerebral infarction	12	—
Humeral fracture with torsion nerve injury	3	—
Cerebral tumor	2	—
Healthy	—	120
Age ± SD (years)	57.6 ± 16.8	54.8 ± 27.8

student at Xi'an Medical University (Xi'an, China) in 1994 the author discovered the extensor digitorum reflex. In 2006, Tan first reported the extensor digitorum reflex and named it the middle-finger or Tan reflex[1]. It is also known as the Braunecker-Effenberg reflex. In the present study, the extensor digitorum reflex was included in neurological examinations to assess its value and specificity.

Methods

Patients

This prospective study included a group of 65 patients with hemiplegia and upper-limb paralysis and a control group of 120 apparently healthy persons, randomly selected. The diagnosis and location of lesions were confirmed with CT, MRI, or X-ray examinations, as well as the patients' history, symptoms, and clinical signs. The clinical data and diagnoses of the subjects are shown in **Table 1**.

Methods of Examination

Each subject was awake and relaxed and was positioned symmetrically, either sitting or lying supine with the arm midway between flexion and extension. The extensor digitorum, biceps, and brachioradialis reflexes were elicited in series in each subject with an identical reflex clinical hammer according to the following methods[2]. After obtaining the reflection intensity on one side, the examiner immediately tested the opposite side for comparison. If necessary, maneuvers of reinforcement were applied to enhance the chances of obtaining the reflexes[3].

(1) Extensor digitorum reflex: One of the examiner's hands was placed under the patient's arm, to hold the patient's elbow. This helped the subject relax the muscle and enabled the examiner to feel the extensor digitorum contract when the tendon was struck. The common tendon was located with the examiner's thumb (usually in the upper-middle posterior surface of the forearm). When the extensor digitorum tendon was tapped with the reflex hammer or pressed by the examiner's thumb, the middle finger normally extended simultaneously with contraction of the extensor digitorum (**Fig. 1**).

(2) Biceps Reflex: The subject's forearm was supported, by resting either on the subject's thighs or on the examiner's forearm. The arm was midway between flexion and extension. With the examiner's thumb placed firmly over the biceps tendon and the examiner's fingers curling around the elbow, the biceps was tapped briskly. The forearm normally flexes at the elbow.

(3) Brachioradialis Reflex: The patient's arm was supported. The brachioradialis tendon was identified at the wrist. The examiner placed the thumb of the hand supporting the patient's elbow on the biceps tendon. As the brachioradialis tendon was tapped with the examiner's other hand, the forearm normally flexes and supinates at the elbow.

Record Results

The deep tendon reflexes were graded on a scale of 0 to 4 by convention as follows: absent or weak (0), diminished/depressed/hypoactive (1+), normal (2+), abnormally brisk or hyperactive, without clonus (3+), and very brisk/hyperactive, clonic or sustained clonic (4+). Reflection intensity was compared with that of the contralateral limb[3].

In the control group, reflexes given a score of 2+ (normal) were considered negative (true negative).

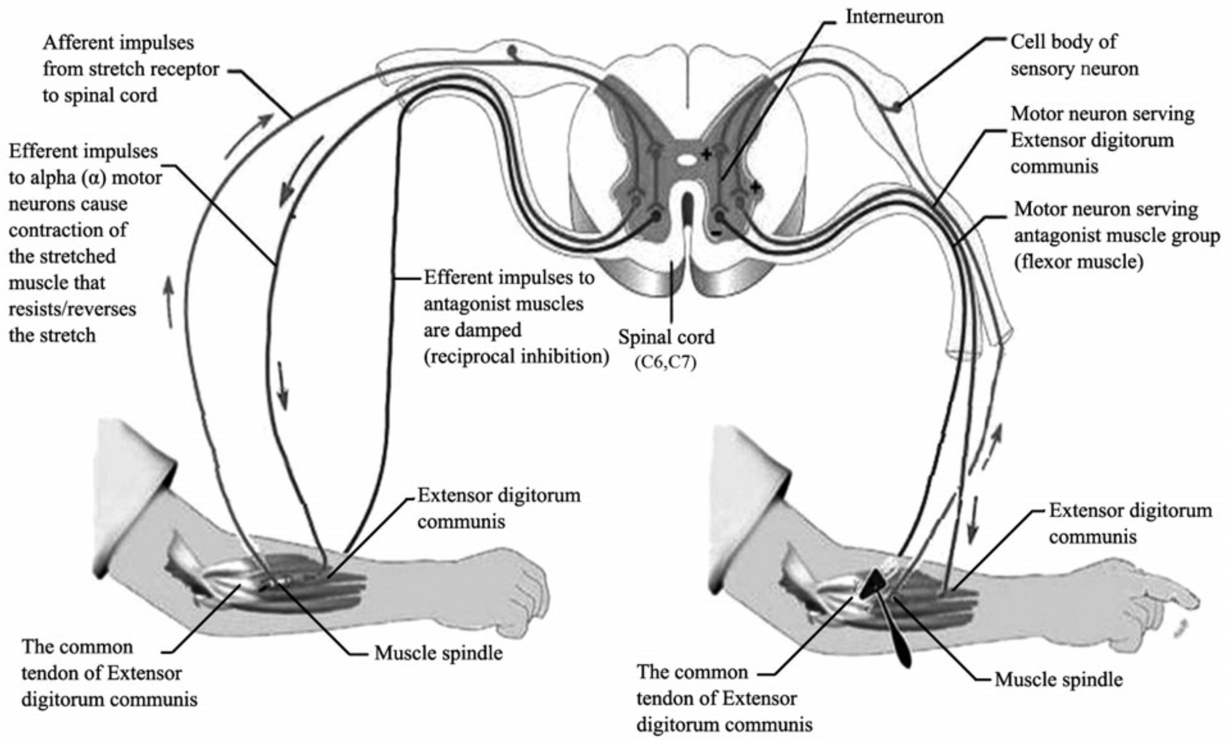

Fig. 1

Reflexes that were given scores other than 2+ were considered positive (false positive) because the deep reflex arc of each subject was neurologically intact.

In the patient group, all reflexes that were given scores other than 2+ were considered positive (true positive). Reflexes that were given a score of 2+ (normal) were considered negative (false negative) because the deep reflex arc of each subject was neurologically impaired.

Statistical Analysis

Sensitivity, specificity and diagnostic efficacies of each method were noted and results were analyzed using a Z-test.

Results

The sensitivities of the extensor digitorum, biceps, and brachioradialis reflexes were 93.65%, 90.48%, and 90.48%, respectively. The specificities of the extensor digitorum, biceps, and brachioradialis reflexes were 95.83%, 94.17%, and 93.33%, respectively. The diagnostic efficacies of the extensor digitorum, biceps, and brachioradialis reflexes were 95.08%, 92.90%, and 91.26%, respectively (**Table 2**). There were no significant differences ($p>0.05$) in the sensitivities, specificities, and diagnostic accuracy among the extensor digitorum, biceps, or brachioradialis reflexes in neurologic examination.

Discussion

The neurologic examination remains the standard for the determination of lesions in the nervous system. During the neurologic examination deep tendon reflexes are elicited to identify and pinpoint lesions in the nervous system and their relationships to the motor system. As a result, such lesions are often located with remarkable accuracy. Deep tendon reflex is the contraction of a muscle in response to the stretching of the muscle spindles when tapped with a reflex hammer. By the turn of the 20th century, since Sherrington[4] and Eccles[5] demonstrated and analyzed the physiological anatomy of the monosynaptic reflex arc, of reciprocal inhibition, and of propriospinal neurons, and the synaptic mechanisms themselves, the mechanism of the deep tendon reflex had been revealed. The muscle contracts due to a 2-neuron reflex arc involving the spinal or brainstem segment

Table 2 The sensitivity, specificity and diagnostic coincidence of 3 deep tendon reflexes

Items	Extensor digitorum reflex		Biceps Reflex		Brachioradialis Reflex	
	+	−	+	−	+	−
Patients (number)	59	4	57	6	57	6
Controls (number)	5	115	7	113	8	112
Sensitivity	93.65%		90.48%		90.48%	
Specificity	95.83%		94.17%		93.33%	
Diagnostic coincidence	95.08%		92.90%		91.26%	

Notes: Sensitivity = true positive ÷ (true positive + false negative) ×100%;
Specificity = true negative ÷ (true negative + false positive) ×100%;
Diagnostic coincidence = (true positive + true negative) ÷ (true positive + false positive + true negative + false negative) ×100%

that innervates the muscle[6,7].

The extensor digitorum reflex is an example of a monosynaptic reflex (as is the biceps and brachioradialis reflexes). The reflex arc of the extensor digitorum involves receptors (muscle spindles in the extensor digitorum), afferent fibers (α fibers), center (spinal cord C6, C7), efferent neurons (alpha motor neurons), and an effector organ (extensor digitorum muscle). The dynamic stretch reflexes of the biceps and brachioradialis reflexes involve the C5/C6 spinal segment.

The effector organ, the extensor digitorum communis, arises from the lateral epicondyle of the humerus. From the antebrachial fascia, the muscle's common tendon divides into 4 tendons, which pass and then diverge over the back of the hand and are inserted into the second and third phalanges of the middle, ring, and little fingers. The extensor digitorum communis is innervated through the deep radial nerve by the seventh cervical (C6/C7) segment. The main function of the extensor digitorum communis is to extend the 3 digits (2nd, 3rd, and 4th) of the hands, then the wrist, and finally the elbow. Thus, when the extensor digitorum is passively stretched the muscle spindles are also stretched, deforming the annulospiral ending. Throughout the intact reflex arc, it contracts the muscle fibers of the extensor digitorum, resulting in extension of the middle finger.

In this study, the sensibility and specificity of the extensor digitorum reflex were evaluated by using the biceps and brachioradialis reflexes as controls. The results show that there were no significant differences ($p>0.05$) among the extensor digitorum, biceps, and brachioradialis reflexes in the neurologic examination. Therefore the extensor digitorum reflex is just as effective as the biceps and brachioradialis reflexes. It can be used as a new deep tendon reflex in the neurologic examination.

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