Prevalence of Accessory Deep Peroneal Nerve in Sample of Bosnia and Herzegovina Subjects: an Electrophysiological Study

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ABSTRACT

Background: The accessory deep peroneal nerve (ADPN) is as an anomalous nerve derived from the superficial peroneal nerve or its branch and supplies motor innervations for extensor digitorum brevis (EDB) and sensory innervations for the lateral part of the ankle and foot regions. It is the most common anomalous innervation present in the lower limb. **Objective:** The aim of this study was to determine the prevalence of ADPN electrophysiologically in a sample of Bosnia and Herzegovina subjects who referred to an electromyography lab. **Methods:** This cross-sectional descriptive study included 316 lower limbs from 171 subjects referred for electrodiagnostic studies to Electromyography Lab, Department of Neurology, University Clinical Center Tuzla (Bosnia and Herzegovina) (102 females/60% and 69/40% males). Motor nerve conduction studies for the peroneal nerve and ADPN were done. Compound muscle action potential (CMAP) and nerve conduction velocity (NCV) of deep peroneal nerve (DPN) were measured by using EMG machine by stimulating DPN at knee, ankle and lateral malleolus areas accordingly, with recording from extensor digitorum brevis (EDB) muscle. **Results:** ADPN was found in 46 (14.5%) of 316 legs. ADPN was found in 18 (39.1%) right lower limbs and 28 (60.9%) left lower limbs. Ten subjects (5.8%) had bilateral ADPN. There was no statistically significant difference between the occurrence of ADPN in women versus men ($p=0.757$), as well as in right versus left legs ($p=0.237$). **Conclusion:** This study demonstrated that ADPN prevalence, in a sample of Bosnia and Herzegovina subjects who referred to an electromyography lab is 14.5%. Recognition of ADPN is very important for proper interpretation of lower limbs electrophysiological data.

Keywords: Accessory deep peroneal nerve, Neurophysiology, Clinical significance.

1. BACKGROUND

An anatomical anomalies of peripheral nerves of the upper and lower extremities are common and influence the interpretation of neurophysiological studies in normal subjects and clinical features of those with peripheral nerve lesions (1).

Namely, in the course of an neurophysiological investigation of a peripheral nerve lesion, the examiner may be confronted with unexpected findings in contradiction with the clinical picture. Awareness of such anomalies is important in order to avoid misdiagnoses during electrophysiological study, such as a conduction block involving the ulnar nerve or carpal tunnel syndrome or

axonal lesion of the peroneal nerve (1-5).

The most widely recognized anatomical anomalies of peripheral nerves are a Martin-Gruber anastomosis (MGA), and an accessory deep peroneal nerve. Awareness of such anomalies may be important in order to avoid misdiagnoses during electrophysiological study, such as a conduction block involving the ulnar nerve or carpal tunnel syndrome or axonal lesion of the peroneal nerve (6).

The deep peroneal nerve innervates the peroneus tertius muscle and the dorsiflexors of the ankle and toes, including the tibialis anterior muscle, extensor digitorum longus and extensor hallucis longus, and ex-

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Figure 1. Muscle extensor digitorum brevis exclusively innervated by accessory deep peroneal nerve a) action potential evoked when stimulating the deep peroneal nerve at the ankle; b) action potential evoked when stimulating the common peroneal at the knee; c) no action potential when stimulating the accessory deep peroneal nerve

tensor digitorum brevis (1, 7).

The accessory deep peroneal nerve has been regarded as an anomalous nerve derived from the superficial peroneal nerve or its branch and supplies motor innervations for extensor digitorum brevis (EDB) and sensory innervations for the lateral part of the ankle and foot regions (8). ADPN arises from the superficial peroneal nerve on the lateral aspects of the leg, descends along the posterior border of the peroneus brevis muscle near to the Achilles tendon and sural nerve and winds around the lateral malleolus (9).

The first anatomical description of ADPN was provided by Bryce (1891, 1901), but it was initially reported by Ruge in 1878. Winckler published in 1934 a more detailed analysis of this nerve and reported a more frequent occurrence in man (7 of 19 legs) (8).

From the late 1960s, this anomalous variation has been reported to occur in 12-35% of the population (8-11). This anomaly has an autosomal dominant pattern of inheritance in man (12-14).

The EDB is usually innervated exclusively by the deep peroneal nerve, however, in some cases, one or both of the EDB muscles are (Figure 1) innervated by the ADPN nerve and could be detected by nerve conduction studies (10, 14-15).

There are no many updates about prevalence of this anatomic variation. Electromyography lab is the best environment for detecting presence and prevalence of this nerve, so present study enrolled. Up to our knowledge, no study about the prevalence of ADPN among Bosnian subjects has been published till now.

2. OBJECTIVE

The aim of this study was to determine the prevalence of ADPN electrophysiologically in a sample of Bosnian individuals who referred to an electromyography lab.

3. PATIENTS AND METHODS

In this cross sectional descriptive study 171 cases comprising 316 legs referred for electrodiagnostic studies to Electromyography Lab, Department of Neurology, University Clinical Center Tuzla participated in the study. Compound muscle action potential (CMAP) and nerve conduction velocity (NCV) of deep peroneal nerve (DPN) were measured by using EMG machine by stimulating DPN at knee, ankle and lateral malleolus areas accordingly, with recording from extensor digitorum brevis muscle.

Study received institutional ethics approval, and written informed consent was obtained from participants.

4. RESULTS

The study population included 102 females (60%) and 69 (40%) males with mean age of 48 ± 15.7 . There was no statistically significant difference between the occurrence of ADPN in women versus men ($P=0.757$). ADPN was detected in 46 (14.5%) legs, 18 (39.1%) in right lower limbs and 28 (60.9%) in left lower limbs. Ten subjects (5.84%) had bilateral ADPN.

There was no statistically significant difference between the occurrence of ADPN in right versus left lower limbs ($p=0.237$). In subjects without ADPN, the average motor conduction velocity (MCV) was 47 ± 4.8 m/s, and in cases with ADPN it was 48.1 ± 5.4 m/s ($p=0.390$). The average distal latencies were also similar and without sta-

Figure 2. Muscle extensor digitorum brevis partially innervated by accessory deep peroneal nerve. a) action potential evoked when stimulating the deep peroneal nerve at the ankle; b) action potential evoked when stimulating the common peroneal at the knee; c) action potential evoked when stimulating the accessory deep peroneal nerve

tistical significances (subjects without ADPN 4.3 ± 1.05 ms, and subjects with ADPN 4.6 ± 1.09 ms)($p=0.167$).

5. DISCUSSION

Peripheral nerves anomalous innervations are important aspects in routine neurophysiological assessment of any patient. Unrecognition of these anomalous innervations can be mistaken for technical pitfalls or for actual pathology (6, 16, 17). The prevalence of ADPN in a sample of Bosnia and Herzegovina subject was 14.5%.

Electrophysiologically exam

The prevalence of ADPN in this study was within the range of prevalence of ADPN present in other studies which varies from 12 to 35% among the studied subjects (11, 17).

It was found that there is a wide variation of prevalence of ADPN among different studies (11-15). One a meta-analysis study assessed the overall pooled ADPN prevalence of 18.8%, the electrophysiological pooled ADPN prevalence of 13.6%, and the anatomical pooled prevalence of 39.3% (18). This could be explained by the differences between studies regarding the studied population and the techniques used in the assessment of ADPN, whether anatomical or electrophysiological studies (11,16).

In this research, there was no statistically significant difference between women and men as regards the frequency of ADPN, as well as in case of occurrence of ADPN in right legs versus left legs. This was in agreement with other studies (16, 19-20).

In this study, unilateral ADPN was present in over 90% of the subjects with ADPN. This was in agreement with

previous studies which reported that unilateral ADPN was more common than bilateral ADPN (7, 16, 19-20).

The ADPN has more than one clinical importance (8, 14, 16, 18). Studying the ADPN can complicate the clinical picture and disturb the interpretation of the electrophysiological studies of common peroneal, deep peroneal, and superficial peroneal nerves lesions and injuries, as well as, ADPN neuropathy (8, 16).

Namely, superficial peroneal nerve and its branches (including ADPN) are risk for iatrogenic damage while performing arthroscopy, local anesthetic block, surgical approach to the fibula, open reduction and internal fixation of lateral malleolar fractures, application of external fixators, elevation of a fasciocutaneous or fibular flaps for grafting, surgical decompression of neurovascular structures, or miscellaneous surgery on leg, foot and ankle (14, 18).

Accordingly, ADPN existence is of great clinical and surgical importance as well as its recognition for proper interpretation of electrophysiological data, which avoids the error in the diagnosis of peroneal nerves lesions.

This study had a sampling limitation as it was conducted only in one clinical study, and it was difficult to generalize these results to all Bosnia and Herzegovina population. Further studies are recommended on a larger scale of Bosnian subjects from different medical centers for proper and wider calculation of the prevalence of ADPN among Bosnia and Herzegovina population.

6. CONCLUSION

The prevalence of ADPN in Bosnia and Herzegovina subjects in this study was (14.5%) (5.8% had bilateral ADPN), with no sex or side difference. ADPN existence is of great clinical and surgical importance. Furthermore, its recognition is important for proper interpretation of electrophysiological data, which avoids the error in the diagnosis of peroneal nerves lesions.

- **Patients Consent Form:** Written informed consent was obtained from participants.
- **Author's contribution:** All authors were involved in all steps of preparation this article. Also, all authors were approved of the final text of the article and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.
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