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Characteristics of Electrodiagnosis in Drop Foot Patients at Neurological Polyclinics

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Abstract
Introduction: *Drop foot is the inability to lift the front leg due to the dorsoflexion weakness of the foot, which causes an unsafe gait and potentially results in a fall. This weakness is often caused by compression neuropathy of the peroneal nerve and can result from injuries at various levels of the nervous system. Other causes include metabolic diseases such as diabetes mellitus as well as neurodegenerative, neuromuscular, and inflammatory conditions. The gold standard for diagnosing peroneal neuropathy is electrodiagnostic testing, including nerve conduction studies and needle electromyography, which are useful for detecting lesions and differentiating the degree of lesion in the nervous system.* ***Objective:*** *This study aims to determine the characteristics of drop foot patients who undergo electrodiagnostic examinations, especially the results of Compound Muscle Action Potential (CMAP) and Sensory Nerve Action Potential (SNAP), at the Neurological Polyclinic of Professor IGNG Ngoerah Hospital Denpasar, Bali.* ***Method:*** *This study used a cross-section descriptive study. Data was collected from the medical records of patients who underwent electrodiagnostic examinations at the neurological polyclinic of Professor IGNG Ngoerah Hospital. Data analysis was conducted to evaluate the characteristics of CMAP and SNAP in patients with drop foot complaints.* ***Result and Discussion:*** *the study showed that as many as 80% of drop foot patients were male, electrodiagnostic examination, in CMAP assessed the peroneal and tibial nerves, the motor nerve transmission there were 100% lesions on the peroneal nerve at all levels of lesion location. Meanwhile, different results can be seen from the assessment of SNAP function where what is assessed is the surreal nerve in each different lesion group.* ***Conclusion:*** *Electrodiagnostic examinations, particularly CMAP and SNAP analysis, are effective in identifying peroneal neuropathy as the cause of foot drop. This study supports the importance of electrodiagnostic examination to determine the location of the lesion and plays a role in the treatment and prognosis of patients with drop foot complaints in the neurological polyclinic.*
Keyword: Electrodiagnosis; Drop Foot; Polyclinic Saraf;

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Introduction

Drop foot is the inability to lift the front leg due to the dorsoflexion of the foot, this can lead to incorrect gait, unsafe and potentially result in a person being able to fall (Stretansky, n.d.). This complaint It began to appear from the results of the muscle strength test that it was less than 3/5, which is when the legs can no longer be actively lifted to resist gravity, so that an abnormal pattern arises that affects the phase when standing and the phase of swinging the legs. In order to prevent the front foot from stumbling on the floor, the body will compensate for hyperflexion in the hip and knee joints and in addition to the internal rotation of the foot in the transverse plane, which in the long term can cause improper body frame axis. As a result of this muscle imbalance causing a permanent shortening of the plantar flexor tendon and the Achilles tendon, the equines position of the foot begins to form (Carolus et al., 2019)

Condition This can lead to impaired motor and sensory functions, the cause of the inability to perform dorsoflexion movements in the legs is in principle an injury to the motor pathway of the muscles involved in dorsoflexion movements, which can occur at any level, from the central nervous system to the peripherals, or can also occur simultaneously at several levels (Carolus et al., 2019), (Ferdiansyah & Chilmi, 2022). The most common cause of acute weakness of the lower limbs is compression neuropathy of the peroneal nerve (Garg, 2016). Other causes Metabolic diseases such as diabetes mellitus as well as neurodegenative, neuromuscular and inflammatory processes can also cause *drop foot*.

The gold standard for diagnosing peroneal neuropathy is electrodiagnostic testing, which includes nerve conduction studies and needle electromyography that can detect the presence of a lesion (Pugdahl et al., 2020). Electroneuromyography examination is also a nerve conduction examination that includes the speed of nerve conduction to *Compound Muscle Action Potentials (CMAP)* and SNAP *(Sensory Nerve Action Potentials)* useful for distinguishing the level of lesions in Plexus Lumbala's, Nervus sciatica's, Nervus peroneus (STUDIES, 2015). The most common cause of this state is compression of the branching of the peroneus longus nervus which is located long and more superficial (Poage et al., 2016). This study is expected to find out the characteristics of drop foot patients who undergo electrodiagnostic examinations, especially the results of *Compound Muscle Action Potential* (CMAP) in *Sensory Nerve Action Potential* (SNAP) in patients with complaints *drop foot* at the neurological polyclinic of Professor IGNG Ngoerah Hospital Denpasar, Bali.

Method

This study is a descriptive study of cross-cutting in all patients with clinical symptoms *of drop foot* who visited the neurosurgery polyclinic of Professor IGNG Ngoerah Hospital Denpasar for the period January 2020 to August 2022. The data was obtained after the patient underwent an ENMG examination using *a Keypoint Dantex 6 Ch Amp ENMG* machine produced in Germany in 2015.

Electrodiagnostic examination was carried out by recording the function *of Compound Muscle Action Potential* (CMAP) and *Sensory Nerve Action Potential* (SNAP) on several nerves representing the components of the lumbosacral plexus, namely the peroneus longus nerve, anterior tibialis, suralis, gastrocnemius, biceps femoris, gluteus medius, paravertebral L4-L5. After that, several values such as distal latency, amplitude, and nerve conduction velocity (KHS) will be taken and then conclusions will be drawn. Based on the muscle patterns involved, the lesions are then further classified as peroneus neuropathy as high as the fibula capites, ischidial nerve neuropathy, L5-S1 radicolupathy.

The criteria of this researcher were that all patients with complaints of inability to perform dorsiflexion movements in the legs, in the absence of other neurological deficits. The electrode installation is carried out by experienced medical personnel and all recording results are read by an electrophysiology consultant.

Result and Discussion

Result

Of the 30 patients with clinical complaints *of drop foot* who visited the neurological polyclinic of Professor IGNG Ngoerah Hospital Denpasar, there were 24 male patients (80%) and 6 female patients (20%) with a vulnerable age from the youngest 12 years old to 82 years old. From the data obtained after the anamnesis, in 18 patients (60%) lesions were located on the right extremity and in 12 patients lesions were located on the left side (40%). After an electrodiagnostic examination, 20 patients (66.7%) with peroneal nerve lesions were found, the second most lesions on the L5-S1 radix were 8 patients (26.7%) and there were only 2 patients (6.6%) with lesions on the ischiatic nerve.

Table 1

Characteristics of the research subject

Variable	Total (N)	Percentage (%)
Gender		
Man	24	80
Woman	6	20
Age		
12 - 1 6 years	1	3,3
17 - 25 years old	2	6,7
26 - 35 years old	5	16,7
36 - 45 years old	5	16,7
46 - 55 years old	3	10
56 - 65 years old	10	33,3
≥ 65 years	4	13,3
Lesion Side		
Right	18	60
Left	12	40
Location of the Lesion		
Nervus Peroneus as well as kaput fibula	20	66,7
Nervus Ischiatic	2	6.6
Radix L5-S1	8	26,7

From the results of data processing from electrodiagnostic examinations, abnormalities in latency, amplitude, and Nerve Conduction Velocity (KHS) values in *Compound Muscle Action Potentials* (CMAP), and Sensory *Nerve Action Potential* (SNAP) examinations, at each lesion site

Table 2

Profile electrodiagnostic

Location of the Lesion	Conduction Transmit nerve peroneus nerve			
	CAMP		SNAP	
	Normal (%)	Abnormal (%)	Normal (%)	Abnormal (%)
Peroneus Neuropathy Nervus as high as the fibula caps				
- N.Tibialis	9 (45)	11 (55)	-	-
- N. Peroneus	-	20 (100)	-	-
- N. Suralis	-	-	9 (45)	11 (55)
Neuropath nervus ischiatic				
- N.Tibialis	-	2 (100)	-	-
- N. Peroneus	-	2 (100)	-	-
- N.Suralis	-	-	-	2 (100)
Radiculopathies L5-S1				
- N.Tibialis	1 (12,5)	7 (87,5)	-	-
- N. Peroneus	-	8 (100)	-	-
- N.Suralis	-	-	3 (37,5)	5 (62,5)

The average normal and abnormal values were based on the presence or absence of extended latency, decreased amplitude, and slowing of nerve conduction velocity (KHS) results. In the motor examination, the peroneal and tibial nerves are seen, where the result of the motor nerve transmission is 100% lesions on the peroneal nerve at all levels of lesion location. Meanwhile, different results can be seen from the assessment of Sensory *Nerve Action Potential* (SNAP) function, where what is assessed is the surreal nerve in each different lesion group. Peroneus nerve lesions as high as the fibula caput were obtained 55% abnormal, lesions in the ischiadicus nerve were 100% and in the L5-S1 radix were obtained abnormal values of 62.5%.

Discussion

Drop foot It is a clinical diagnosis where the legs are unable to perform dorsiflexion movements, where patients usually come to treatment after the complaints, they feel are getting worse such as the patient cannot climb stairs. *Drop foot* can be caused by trauma or several diseases such as diabetes mellitus, The most common cause of acute weakness of the lower limbs is compression neuropathy of the peroneal nerve (Meria & Kurniawan, 2023). Based on the results of the above study, 30 patients visited the neurological polyclinic in a period of 2.5 years from January 2018 to August 2022, of which 24 patients were men and 6 patients were women, the number of visits during this period was also influenced by the situation where the COVID-19 pandemic hit which began in early 2020, which had a significant effect on the overall number of visits from outpatients at the Neurological Polyclinic.

The number of research subjects with the most drop foot complaints was 24 men or 80% and 6 women (20%), this is in accordance with the literature that men are more than women 2.8:1. The age category used in this study is based on the Ministry of Health of the Republic of Indonesia in 2009, namely toddlerhood = 0 - 5 years, childhood = 5 - 11 years, early adolescence = 12 - 16 years. late adolescence =17 - 25 years old Early adulthood = 26- 35 years old, late adulthood = 36- 45 years, early elderly 46-55 years, late elderly 56-65 years, and seniors from 65 years and above, and based on the profile of patients who come the most is at the vulnerable age of the early elderly and followed by the early to late adult age group.

Any lesion on the motor pathway involved from a dorsiflexion movement in the leg can occur at any level, starting from the center to the periphery, or it can occur simultaneously (Bahrudin, 2019). The central cause of this complaint is the presence of stroke, the effect of edema, inflammation and tumors in the central nervous system, the second is in the spinal nerve which can be caused by a herniation that presses on the root of the L5 nerve, can cause complaints *drop foot*, and the third is the cause of lesions in the lumboscasal area, ischiadikus nerve and peroneus nerve (Chapman & Sherwin, 2013). In this study, the causes of complaints *drop foot* The central is already an exclusion criterion, while the lesions that occur in the peripheral nerves that cause the appearance of these complaints are lesions of the peroneus nerve, said to occur in 15% of all mononeuropathies in adulthood.

This is in accordance with the results of the current study where in a period of 2.5 years there were 66.7% or as many as 20 cases of lesions located in the nevus peroneus as high as the fibula caput. The peroneus nerve is anatomically located very superficially and is very susceptible to direct compression, when passing through the fibula cap, this is the basis where this place is the most frequent location for neuropathy in the lower extremities. And for the right or left side of the lesion with the most, there is no supporting data that shows the most lesion side, but from this study the results were obtained on the right side as many as 18 cases (60%) and the left side as many as 12 cases (40%).

Nerve conduction velocity (KHS) and electromyography (EMG) tests are the gold standard for diagnosing suspicion of peroneal nerve paralysis. This examination helps the clinician evaluate the motor and sensory axons of the peroneus nerve and its branches. This examination is also to localize the location of the injury, determine the severity of the lesion, and monitor recovery after a nerve injury has been identified. Electrophysiological examinations should be done to get the basis in all patients who come with a new onset. Foot drops, the examination can be repeated every 3 months to monitor for improvement or decline.

An examination of the KHS should be performed to evaluate the EDB (extensor digitorum brevis) and TA (anterior tibialis) muscles, with stimulation applied above and below the head of the fibula. These results should be compared with the collateral extremities. Because EDB can be innervated by the accessory peroneal nerve of the super physiological peroneus nerve.

Examinations involving the distribution of tibial and sural is nerves may be performed to help rule out other causes of clinical findings, including plexopathy or injury to the ischiatic nerve. KHS parameters indicating focal lesions of the fibula head: a significant decrease in conduction velocity between the ankle to the lower fibula caput segment compared to the contralateral fibula segment or a significant decrease in action potential indicating conduction block or focal demilination. A decrease in fibula motor amplitude greater than 20% across the knee segment has a specificity of 99% in localizing fibula nerve lesions in the knee. Stimulation of short segments of the fibula nerve across the knee segment has also been described.

An examination with an EMG needle provides further details to help in identifying the location and severity of peroneal nerve lesions. The muscles innervated by the peroneus include the anterior tibial muscle, which is most often affected Examinations can also be performed on the biceps femoris muscle to identify more proximal lesions or injuries to the ischiatic nerve. If the findings are abnormal then the needle EMG examination should be expanded to include more innervated muscles of the L5-S1 radix i.e. gluteal muscles, and lumbosacral paraspinal muscles

Conclusion

Drop foot is the inability of the foot to perform dorsoflexion movements which can be caused by many factors, but the most common cause of this clinical condition is peroneus neuropathy, which anatomically in the superficial branching is very easy to experience complications in the caput area of the fibula. Electrodiagnostic examination, very important to determine the location of the lesion and also play a role in determining the prognosis, the examination should be carried out on both extremities.

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