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Case presentation

Medical management and rehabilitation in posttraumatic common peroneal nerve palsy

Florina Ligia Popa [1], Cosmina Diaconu [2], Adriana Canciu [3], Viorela Mihaela Ciortea [4], Mădălina Gabriela Iliescu [5]*, Mihaela Stanciu [6]

[1] Physical Medicine and Rehabilitation Department, "Lucian Blaga" University of Sibiu, Faculty of Medicine, Academic Emergency Hospital of Sibiu, Sibiu, Romania
[2] Nursing Department, "Lucian Blaga" University of Sibiu, Faculty of Medicine, Academic Emergency Hospital of Sibiu, Sibiu, Romania
[3] Academic Emergency Hospital of Sibiu, Sibiu, Romania
[4] "Iuliu Hatieganu" University of Medicine and Pharmacy Cluj-Napoca, Department of Rehabilitation, Clinical Rehabilitation Hospital Cluj-Napoca, Romania
[5] Faculty of Medicine, 'Ovidius' University of Constanta, Constanta, Romania, Balneal and Rehabilitation Sanatorium Techirghiol, Techirghiol, Romania
[6] Department of Endocrinology,"Lucian Blaga" University of Sibiu, Academic Emergency Hospital of Sibiu, Sibiu, Romania

* Correspondences: Mădălina Gabriela Iliescu, E-mail: iliescumadalina@gmail.com

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ABSTRACT: Introduction. The common peroneal nerve and the tibial nerve are the two major components into which the sciatic nerve divides. The severity of common peroneal nerve damage depends on the aetiopathogenic mechanism and the place of injury. The peroneal ram of the sciatic nerve injury is the most common cause of mononeuropathy of the lower limb which can cause a significant disability if is not properly diagnosed and treated. Material and method. We present the case of a 40-year-old patient who suffered a polytrauma by road accident resulting in left trochanteric-diaphyseal femoral comminuted open fracture, lacerated wound on the posterolateral middle third of the left thigh, left sacral wing fracture without displacement, left L1, L2, L3 transverse apophyseal fractures and splenic laceration, treated surgically and orthopedically. The patient was admitted to the Medical Reabilitation Department of Sibiu for left leg motor deficit, mechanical pain and functional deficit of the left hip and ankle, gait disorders. Complex rehabilitation treatment was initiated 3 months after the accident. Results and discussion. Common peroneal nerve palsy was confirmed following neurological consultation the day after admission to Orthopaedics-Traumatology Department of Sibiu where continuous extension-traction was performed in order to relax the fracture and subsequent osteosynthesis surgery of the femur fracture. The presence of a deep and lacerating wound on the posterolateral left thigh caused the nerve injury. The coagulase-negative Staphylococcus aureus overinfection of the wound required secondary suturing and subsequently led to fibrous scar formation, adversely affecting the post-injury repair of the common fibular nerve. Conclusions. In patients with posttraumatic common peroneal nerve palsy, early diagnosis and appropriate treatment, including medical rehabilitation, are essential. Medical rehabilitation should be continued on a sustained basis because nerve regeneration occurs slowly. The prognosis mainly depends on the severity of the initial nerve injury.

Keywords: *common fibular nerve injury, polytrauma, medical rehabilitation*

1. INTRODUCTION

Traumatic injury to the common peroneal nerve can occur by several mechanisms: compression, tearing, crushing, traction/stretching, ischaemia, thermal injury or high velocity

trauma [1]. The injury can occur at any level of the peripheral nerve pathway, but most commonly occurs at the fibular head where it becomes superficial [1,2].
Compresion/entrapment syndrome is common and can affect almost any peripheral nerve, usually occurring in its distal territory [1]. Compression can be acute or chronic, leading to changes in microcirculation within the nerve, altered axonal transport and vascular permeability disorders, contributing to edema and nerve conduction blockages [3]. At the fibular head, the common peroneal nerve presents an area of vulnerability that makes it more prone to injury. The compressive mechanism may be achieved by habitual leg crossing or prolonged squatting, immobilisation of the lower limb in an inappropriate position on a hard surface for a significantly long time (for example during surgery) or in a cast that is too tight or incorrectly positioned [4]. Damage to the common fibular nerve can also occur following various traumatic injuries involving the knee [5].
The most common mechanism of traumatic peripheral nerve injury is transection/dilaceration caused by fractured bone ends or penetrating trauma. In this situation the diagnosis of nerve injury may be delayed due to the association of surrounding tissue injury [1]. Peripheral nerve damage may be aggravated if infection, scar tissue formation, vicious fracture callus or due to the presence of vasculopathy [1].
The common peroneal nerve can also be injured iatrogenically. Continuous transskeletal traction through the tibial tuberosity can lead to injury of this nerve if there is a chronic external instability of the knee [6,7].
The common peroneal nerve has anatomically deficient vascularization. This is provided by only one nutrient artery, unlike the sciatic and posterior tibial nerve in which the vasa nervorum network is represented by 2 to 6 nutrient arteries. Therefore the prognosis is poorer in the case of injury to the common peroneal nerve and necrosis, Wallerian degeneration and fibrous scar formation may occur [8].
Neurodiagnostic tests are useful in assessing the severity, location and prognosis of the nerve lesion [9]. The resulting disability depends on the severity of the lesion and negatively influences the quality of life of these patients if the nerve injury is irreversible [10]. The therapeutic management can be conservative or surgical depending on the severity of the case [11].

Objectives

The aim of our article is to highlight the role and importance of early and sustained rehabilitation in a patient with posttraumatic common peroneal nerve palsy.

Material and method

We present a case of a 40-year-old patient who was admitted to our Rehabilitation Department with left leg motor deficit, mechanical pain and functional deficit of the left hip and ankle, gait disorder. The patient had suffered 3 months ago a polytrauma due to a road accident resulting in left trochanteric-diaphyseal femoral open comminuted fracture, lacerated wound on the posterolateral middle third of the left thigh with involvement of the fascia lata and herniation of the posterior musculature, left sacral wing fracture without displacement, left L1, L2, L3 transverse apophyseal fractures, splenic laceration and haemoperitoneum. Splenectomy and left thigh wound revival were performed. For the trochanter-diaphyseal femoral fracture continuous transskeletal traction through the tibial tuberosity was performed, and then osteosynthesis of the proximal third of the left femur. A motor deficit was found in the left foot since admission to the surgical department. Neurological and neurosurgical consultations were requested and an electromyography was recommended. The evolution of the thigh wound was unfavourable due to a superinfection with coagulazo-negative Staphylococcus aureus and it was necessary to institute appropriate antibiotic therapy, local surgical cleansing and secondary suturing of the wound.


Fig 1. The aspect of deep wound on the posterolateral middle third of the left thigh - clinical appearance on admission to the surgical service.
Fig 2. Postoperative scar on the posterolateral middle third of the left thigh - clinical appearance after 3 months.

Clinical examination revealed: lack of muscle substance and multiple supple postoperative scars on the posterolateral middle third of the left thigh; moderate left gambo-podal edema; left gluteal muscle hypotrophy (positive Trendelenburg sign); pain on left hip mobilization and decreased mobility for flexion = 110°, external rotation and abduction = 30° and internal rotation = 15°; inability to perform left foot eversion and left foot/toe dorsiflexion; evaluation of the muscle strength using the Medical Research Council scale (MRC) highlighted motor deficit in following left lower limb muscles: gluteus medius (value +3/5 MRC), iliopsoas (value 4/5 MRC); hamstrings (value +3/5); anterolateral compartment of the leg (value +1/5 MRC); superficial hypoesthesia on the lateral part of the left leg and dorsal part of the left foot; without pathological changes on examination of deep tendon reflexes; walking difficulties, steppage gait with left foot drop, supported by two Canadian crutches.

Functional evaluation reveals: the visual analog scale (VAS) for pain intensity index = 8, the activities of daily living scale (ADL) index = 8 (quasi-independent), instrumental activities of daily living scale (IADL) index = 6/8 (aided), Functional Ambulation Categories scale (FAC) index = 3 (needs supervision), quality of life scale (Short Form 36 Health Surve - SF 36) score = 64%. According to these results we found a slight to moderate deficit in selfcare and locomotion.

The following images show the results of pre- and postoperative paraclinical investigations. (Fig 3, Fig 4).

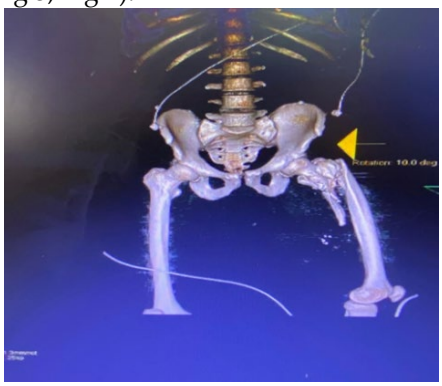
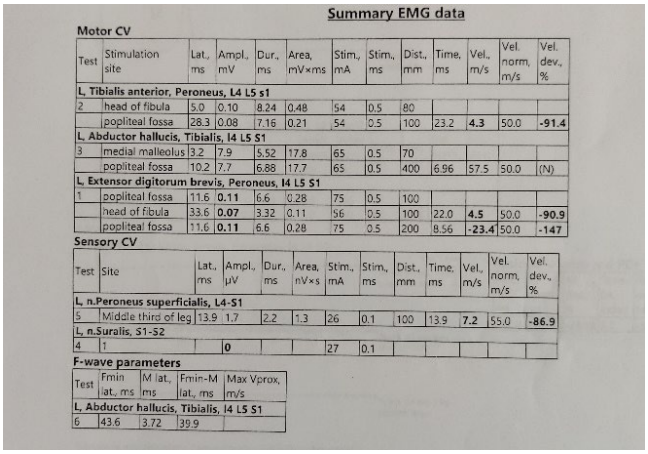



Fig 3. Computer tomography of the pelvis with 3D reconstruction - preoperative view.
Fig 4. Radiological examination of the left hip - comminuted fracture of the proximal left femur, osteosynthesis with Gamma centromedullary rod fixed distally.

The electrodiagnostic study revealed severe axonal degeneration of the left common peroneal nerve and sural nerve. The control electromyography performed five months after the accident highlighted the same aspect (Fig 5).



Summary EMG data

Motor CV

Test	Stimulation site	Lat., ms	Ampl., mV	Dur., ms	Area, mV×ms	Stim., mA	Stim., ms	Dist., mm	Time, ms	Vel., m/s	Vel. norm, m/s	Vel. dev., %
L, Tibialis anterior, Peroneus, L4 L5 s1												
2	head of fibula	5.0	0.10	8.24	0.48	54	0.5	80				
	popliteal fossa	28.3	0.08	7.16	0.21	54	0.5	100	23.2	**4.3**	50.0	**-91.4**
L, Abductor hallucis, Tibialis, I4 L5 S1												
3	medial malleolus	3.2	7.9	5.52	17.8	65	0.5	70				
	popliteal fossa	10.2	7.7	6.88	17.7	65	0.5	400	6.96	57.5	50.0	(N)
L, Extensor digitorum brevis, Peroneus, I4 L5 S1												
1	popliteal fossa	11.6	**0.11**	6.6	0.28	75	0.5	100				
	head of fibula	33.6	**0.07**	3.32	0.11	56	0.5	100	22.0	**4.5**	50.0	**-90.9**
	popliteal fossa	11.6	**0.11**	6.6	0.28	75	0.5	200	8.56	**-23.4**	50.0	**-147**

Sensory CV

Test	Site	Lat., ms	Ampl., µV	Dur., ms	Area, nV×s	Stim., mA	Stim., ms	Dist., mm	Time, ms	Vel., m/s	Vel. norm, m/s	Vel. dev., %
L, n.Peroneus superficialis, L4-S1												
5	Middle thirs of leg	13.9	1.7	2.2	1.3	26	0.1	100	13.9	**7.2**	55.0	**-86.9**
L, n.Suralis, S1-S2												
4	1		**0**			27	0.1					

F-wave parameters

Test	Fmin lat., ms	M lat., ms	Fmin-M lat., ms	Max Vprox, m/s
L, Abductor hallucis, Tibialis, I4 L5 S1				
6	43.6	3.72	39.9	

Fig. 5. Electromyographic examination of the left lower limb 5 months after the trauma.

A Magnetic Resonance Imaging (MRI) of the left thigh was performed 6 months after the trauma, but the result was irrelevant. It was not possible to assess the level of nerve injury due to the existence of numerous artefacts determined by presence of osteosynthesis material.

Results

The objectives of the medical rehabilitation treatment in this case are: atrophy prevention of the left leg denervated muscles, preventing the installation of vicious attitudes and positions, pain relief in the left hip, restoration of joint mobility (hip and left ankle), amelioration of vasculotrophic disorders, restoration of the motor and sensory deficit in the affected lower limb, gait reeducation, socio-familial and professional reintegration.

The patient received neurotrophic drug treatment in our department. The rehabilitation program was performed twice a day for 15 days and consisted of: electrical stimulation with exponential pulses on denervated muscles, kinetotherapy and massage. In addition, pulsed short wave therapy (Diapulse) was instituted for its pain-relieving effects, acceleration of trochanteric fracture healing, facilitation of nerve regeneration, reduction of tissue edema and prevention of keloid scar formation. Fixed ankle-foot orthosis was also recommended to improve gait. It should be noted that rehabilitation treatment was initiated 3 months after the motor deficit installation.

The evolution was favourable with improvement in pain, joint mobility and muscle strength in the left lower limb, except the left foot where only a slight improvement of the motor deficit was observed.

Discussion

In the case presented, the road accident caused a lumbar, abdomino-pelvic and left thigh polytrauma imaging confirmed by cervico-thoraco-abdomino-pelvic computed tomography (CT). The lesional level of the common peroneal nerve was determined based on neurodiagnostic study.

L5 algoparetic radicular involvement by lumbar spine compression was excluded based on imaging investigations and clinically by lack of ankle inversion muscle involvement.

For anatomical reasons, fractures of the L1, L2, L3 left transverse apophyses and fracture of the left sacral wing without displacement cannot be the cause of plexopathy with sciatic nerve injury.

At the same time, based on the abdominal-pelvic CT examination, compression of the lumbar roots L4, L5 in the lower portion or of the sciatic nerve by a post-traumatic hematoma in the iliopsoas or gluteus medius muscle was excluded.

Piriformis syndrome occurs due to compression of the sciatic nerve at the level of the piriformis muscle and mainly affects the peroneal part of the nerve. In very rare cases the major components of the sciatic nerve leave the sacral plexus separately. In this situation the common peroneal nerve crosses the piriformis muscle at the level of the greater sciatic

notch, and the tibial nerve passes inferior to the piriformis muscle. The involvement of only the common peroneal nerve with secondary paralysis can be explained if we consider the compression of only this component in the piriformis muscle. Piriformis syndrome can manifest clinically as muscle weakness of the hamstrings. In our case, muscle strength of the hamstrings was decreased in the context of muscle and tegumentary changes secondary to the posterolateral laceration in the middle third of the left thigh.
The left open trochanteric-diaphyseal fracture could have caused the sciatic nerve trunk injury, but does not explain paralysis of the peroneal nerve alone in this case.
The place where the sciatic nerve divides into its major components (tibial nerve and common peroneal nerve) is highly variable. Most commonly the division occurs at the junction of the middle third and lower third of the thigh near the apex of the popliteal fossa, but it can occur at any level above this point and less commonly below this point. The laceration at the posterolateral middle third of the left thigh may be the cause of common peroneal nerve palsy if the sciatic nerve division is at this level. For clarification MRI examination of the left thigh was performed, but the result was inconclusive.
Iatrogenic causes of common peroneal nerve injury by compression due to direct manipulation during orthopaedic surgery or due to intraoperative positions in abdominal surgery (prolonged compression during lateral rotation of the hip and lower limb with knee flexion) have been excluded [11]. In our case the electromyographic result showed that the nerve lesion occurred above the fibular head, and the motor deficit was noted since admission to the surgical department.
Continuous transskeletal traction through the tibial tuberosity [6,7] applied in femur fractures may result in injury to the common fibular nerve [12,13]. Two cases of transient common peroneal nerve palsy are cited in the literature as a complication of this technique, but both patients had incompetence of the lateral collateral ligament of the knee as a contributing factor [14]. Lateral collateral ligament incompetence causes secondary widening of the lateral compartment of the knee and its varus deformity, with consequent injury to the common peroneal nerve after initiation of transskeletal traction. In our case the motor deficit was observed before this procedure was performed.
The ability to regenerate of a peripheral nerve injured by trauma depends on a number of intrinsec factors (age, tissue nutrition manner, time since nerve injury, type and level of injury) and extrinsec factors (drug or surgical treatment, including postoperative management) [1,9]. Hypoanaesthesia may improve within two years of nerve repair. Recent studies have shown that the injured common fibular nerve regenerates much less compared to that of the tibial nerve [8].
Due to the significant motor deficit in the left leg, functional electrical stimulation would be useful in our patient. There are studies that have demonstrated the efficacy of this method, being associated with increased gait speed and improved gait symmetry [15].
In our patient's case, the severity of the common peroneal nerve injury requires consideration of neuroraphy or nerve transposition. Clinical studies conducted so far do not have scientific evidence on the effectiveness of neuroraphy [16,17].
Gastrocnemius tendon transfer and postoperative medical rehabilitation can be used to correct the "foot drop" and regain the ability to walk without an assistive device. The results of clinical trials have demonstrated the effectiveness of the method [18].
Severe lower limb impairment and pain may be associated with depressive disorders and lower patient motivation to comply with medical rehabilitation treatment [19]. Pain is an insufficiently understood symptom and difficult to tackle and is frequently not totally relieved resulting in low quality of life [20]. In physical medicine and rehabilitation motivation and ambition are very important [21]. It is therefore essential that clear, achievable goals should be set in the rehabilitation programme to improve outcomes [22,23].

Conclusions

The particularity of the case presented is given by the injury of the common peroneal nerve at the level of the left thigh, without involvement of the posterior tibial nerve, in a patient who suffered a polytrauma by road accident resulting in multiple fractures of the spine and lower limb and a deep thigh wound on the path of the sciatic nerve. The patient requires sustained medical rehabilitation treatment. Prognosis is poor due to severe peripheral nerve injury and late initiation of rehabilitation program. However, left common peroneal nerve neuroraphy or nerve transposition remains under discussion.

Patient Consent

In this article was included an informed consent that was obtained from the patient.

Authors' contributions

All authors have equal contribution in this publication.

Conflicts of interest: The authors declare that they have no conflict of interest.

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