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Extracranial Herpetic Paresis

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Abstract

Segmental zoster paresis (SZP) is a rare complication of varicella zoster infection that occurs due to the spread of the infection from the posterior horn of spinal cord to the anterior horn and the motor nerve root. As recognizing segmental zoster paresis is important in the differential diagnosis of muscle weakness of other origin, information about demographic (gender and age), clinical presentation, diagnosis, treatment, and course about published patients with SZP was extracted from PubMed database. SZP is classified into several categories: paresis of upper extremity, lower limb involvement, diaphragmatic involvement, and abdomen involvement. Published experiences have shown that clinical course and electromyoneurography of paretic muscle are the most important in the diagnosis; physical therapy is the most common therapy in these patients and their prognosis is generally good except diaphragmatic paresis, where there is no significant recovery in most number of patients.

Keywords: segmental paresis, varicella zoster, clinical presentation, diagnosis, treatment, course

1. Introduction

Herpes zoster (HZ) is an infection of dorsal root ganglion characterized by a painful cutaneous rash. It is believed that reactivated varicella zoster virus (VZV) migrate from dorsal root ganglion in retrograde direction along the sensory nerve to the skin, where it makes the characteristic dermatomal rash [1].

The initial infection caused by varicella or chickenpox occurs during childhood. After that, the virus then exists as a latent infection of sensory ganglia from which it may reactivate many years later and cause herpes zoster.

The virus can be recovered from skin lesion and can cause an inflammatory reaction in sensory ganglion, dorsal root, and posterior horn of spinal cord [2].

Postherpetic neuralgia is the most common complication associated with extracranial HZ. Pain persisting 90 days or longer after the onset of the shingles rash is called postherpetic neuralgia [3, 4]. Postherpetic neuralgia usually remits spontaneously, but some patients could have pain for all their life.

Beside postherpetic neuralgia, segmental herpetic paresis is another complication of HZ, and they often occur together.

Flaccid muscle paralysis rarely occurs due to the spread of the infection from the posterior horn of spinal cord to the anterior horn and the motor nerve root (**Figure 1**) when weakness generally corresponding to the dermatomes in which cutaneous lesions develop [5].

This finding supports the enhancement of spinal nerve roots on MRI that was clinically symptomatic [6], attributed to autoimmune inflammation or

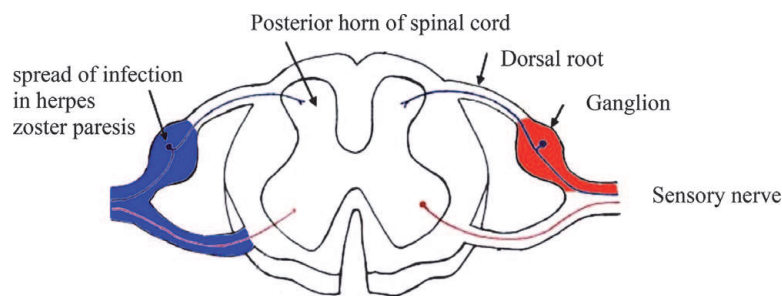


Figure 1.

Origin of segmental zoster paresis: the spread of varicella zoster infection from the posterior horn of spinal cord to the anterior horn and the motor nerve root.

vasculitis [7]; brachial plexus inflammation; and myelin destruction with intact axons found postmortem [8].

The association of muscle paralysis and herpes zoster was first reported by Broadbent in 1866. When he described the case to zoster described as “frozen shoulder” [9], it is noted rarely between 0.5% [10] and 0.8% of segmental motor paralysis between all patients with HZ [11].

In patients with dissociation between motor and dermatomal involvement, a possible explanation could be viral spread to anterior roots without corresponding axonal transport through the sensory nerves [6, 12].

Some patients may have zoster infection without vesicular eruptions, which is called “zoster sine herpette.” This diagnose is safer by a rise VZV antibodies. These patients may have the same neurologic manifestations, including muscular paralysis [13].

As there are no certain standards regarding diagnosis and treatment of segment zoster paresis, we have listed in this paper experiences from literature related to the topic.

The aim of this study was to summarize the experiences related to its clinical manifestation, applied diagnostics, treatment, and patient outcome.

2. Methods

We searched the PubMed database for literature on herpes zoster infection and extracranial motor paresis in adults (last search on September 2019). The search was limited to full-length articles written in English and a study population that included adults aged 18 years and older. A combination of the following search terms was used “herpes zoster, paresis, complications.” As a result, 74 articles were retrieved.

The reference list was also searched for relevant manuscripts not retrieved from PubMed.

Studies included in the final review met the following criteria: (1) infection with herpes zoster virus, (2) motor paresis, and (3) adult study population.

They encompass original articles, technical reports, clinical observations, and single case reports.

3. Results

3.1 Data extraction and synthesis

For comparison across the reports, the sample size was extracted along with demographic information (gender and age), clinical presentation, laboratory

confirmation of herpes zoster, electromyographic (EMG) findings, imaging, treatment, and course.

For clarity, segmental zoster paresis is classified into several categories: paresis of upper extremity, lower limb involvement, diaphragmatic involvement, and abdomen involvement.

Upper extremity involvement: In 37 previously published papers about patients with segmental zoster paresis of arms, there are 19 papers that are processed only as arms paresis (**Table 1**), while the rest of the 18 papers describe patients with segmental zoster paresis of arms and legs (**Table 2**). They include a total of 101 patients with segmental paresis of arms with a mean age of 68.56 ± 11.97 and with 55 women and 45 men and one patient who did not specify gender.

There are few comorbidities in this population of patients: 2 patients with carcinoma mammae, 7 patients suffering from lymphoma, 4 were taking corticosteroids due to autoimmune diseases (2 patients with rheumatoid arthritis, 1 with polymyalgia rheumatica, and 1 with myasthenia gravis), and 4 of them were diabetic.

Clinically, segmental zoster paresis is usually unilateral paresis of arm, predominantly on the right side (42/26, 33 cases do not specify the affected side).

Proximal muscles were affected in most cases (in 52 patients), while the entire arm [40] or only distal muscles [41] were significantly less affected.

Besides weakness, in 9 patients, muscle atrophy was detected.

Phrenic nerve affection followed by dyspnea was observed in 6 patients.

Electromyoneurography was performed in 58 patients, and denervation potential has been described in most cases (51 patients), often associated with reduced pattern and polyphasia of motor unit potentials in most cases (17 patients). Reduced motor or sensor velocity was seen in 4 patients. In some cases, neurophysiological finding was only descriptive: "lesion of nerve," "acute motor axonal lesion," and "severe median and ulnar nerve neuropathy."

Another test was performed in only small number of patients: neck MRI (unremarkable in 2 patients, foraminal stenosis in 1, and protruded disk in 1) and MRI of the affected arm in 1 patient with enlargement of T2 signal of the median nerve.

X-ray of the shoulder was performed in 2 patients (1 patient showed subluxation) and 2 X-rays of the neck (1 unremarkable and 1 with spondyloarthrosis) and 2 X-rays of the chest with 1 showing elevated hemidiaphragm and paralysis confirmed by following fluoroscopy were performed.

Standard laboratory in 2 patients was unremarkable; positive sera antibody test for HZ was found in 3 patients.

Hyperproteinorachia was found in 2 patients and normal CSF was found in 1 patient among patients with lumbar puncture.

In 1 patient, surgical exploration was done and it was without compression.

In almost all cases with a mentioned type of treatment were treated with physical therapy (24 reported patients). Some of them had other therapies: Valacyclovir 3 g/7 days (3 patients), Acyclovir 750 mg/7 days (2 patients iv and 1 per os); and Methylprednisolone 500 mg iv for 3 days (1 patient), and some of them were taking steroids [11], cervical epidural bloc [11], analgesics [42], opioids [43], Amitriptyline [43], Pregabalin [11], and Gabapentin [11].

Most reported patients recovered significantly: complete or near complete recovering is recorded in 8 patients that are reported during following periods: 3 weeks, 1 month, 2 months, 3 months, 6 months, and 2 years. Incomplete recovery was reported in 3 patients, minimal recovery in 1 patient after 2 months, and no recovery after 8 months in 1 patient. One patient recovered from weakness after 5 months but with persisted neuralgia.

Literature	Demographics, medical history	Subjective complaints	Neurological impairments	EMG findings	Other tests	Treatment	Course/Outcome
[14]	58-year old. female	Rash in left shoulder, lateral part of left arm and hand; pain in neck and interscapular region	Weakness of left shoulder, wasting of left <i>M. deltoideus</i>			Exercises	After 2 months, power and mass of <i>M. deltoideus</i> increase
[15]	#1: 82-year old female	Pain and rash in right shoulder and upper arm	Weakness in proximal arm mild elbow flexion contracture	Denervation in deltoid, biceps, supraspinatus; polyphasia and decreased number of MUAP		Moist hot packs, ultrasound, exercise	Incomplete recovery
	#2: 72-year old female, breast carcinoma with mastectomy		Weakness in biceps, deltoid, wrist flexors/ extensors	Denervation in almost all arm muscles; ulnar and median conduction velocities reduced	Not reported	B12 injections, heat, paraffin baths, exercises	Incomplete recovery
	#3: 65-year old female with knee amputation for vascular disease, chronic leukemia	Pain and rash in right arm	Weakness in deltoid, biceps, triceps, wrist extensors, thenar muscles	Marked denervation	Not reported	Heat, electrical stimulation, strengthening exercises	Functional recovery within 6 weeks
	#4: 62-year old female, rheumatoid arthritis	Pain and rash in right arm	Weakness in deltoid, infraspinatus, supraspinatus, biceps	Denervation; polyphasic MUAP	Not reported	Heat, electrical stimulation sling	Some recovery of strength and less pain
	#5: 71-year old female	Pain and rash in right shoulder and forearm	Weakness in deltoid, biceps, wrist flexors/ extensors	Denervation in C7–8/T1 muscles	Not reported	Codeine, whirlpool, paraffin baths	Nearly complete recovery after unknown time period
[16]	#1: 70-year old female	Pain in left shoulder with radiation to arm, hyperesthesia in shoulder and neck; rash in C4–5 dermatomes	Weakness in arm; reflexes absent in biceps, supinator	Denervation in deltoid and biceps muscles	Unremarkable chest X-ray and laboratory work-up	Physical therapy	Full recovery after 3 weeks

Literature	Demographics, medical history	Subjective complaints	Neurological impairments	EMG findings	Other tests	Treatment	Course/Outcome
	#2. 60-year old man, lymphatic leukemia	Rash and hypersensitivity in right C5 dermatome after weeks of coughing; enlarged liver		Not reported	Chest X-ray: elevated right hemidiaphragm, paralysis confirmed on fluoroscopy		Complete recovery after 1 month
[17]	25-year old female	Rash over shoulder	Weakness in deltoid	Not reported	X-ray: shoulder subluxation	Not reported	Full recovery after unspecified number of months
[18]	59-year old man, diabetes, mild hypertension	Pain and rash in left C7 dermatome; hyperalgesia in inner half of left hand	Weakness in whole arm; marked atrophy in almost all arm muscles, reflexes diminished	Fibrillations, reduced interference pattern in atrophied muscles; conduction velocities normal	X-ray: spine normal; CSF: normal	Not reported	Unknown
[13]	#1. 81-year old man	Pain in left arm and left lateral chest wall; rash in C5–7 dermatomes	Complete flaccid weakness of left arm	Not reported	Not reported	Physical therapy	Complete recovery after 3 months
	#2. 75-year old female, diabetes	Pain and rash in right shoulder and over back of the head	Marked weakness in deltoid, biceps, infraspinatus; reflexes absent in biceps	Denervation in infraspinatus, deltoid, biceps; conduction velocities normal	Not reported	Not reported	Minimal recovery after 2 months
[5]	64-year old female	Pain and rash in left inner arm and fingers after 4 months of an episode of shingles	Severe weakness in wrist and hand intrinsic muscles	Lesion of anterior interosseus nerve	Surgical exploration-no compression	Not reported	No recovery after 8 months
[19]	73-year old man, left biceps rupture 10 yrs. earlier with full recovery	Pain in left shoulder; rash over biceps, brachioradialis	Moderate atrophy of deltoid; weakness in biceps and infraspinatus; reflexes	Acute motor axonal lesion in C5–6 dermatomes	Neck MRI: no spinal cord, root compression	Acyclovir, opioid analgesics, amitriptyline, physical therapy, home exercises	Slight deltoid weakness after 2 years

Literature	Demographics, medical history	Subjective complaints	Neurological impairments	EMG findings	Other tests	Treatment	Course/Outcome
			diminished in biceps, brachioradialis muscle				
[7]	72-year old man with oral prednisolone due to myasthenia gravis	Rash in left C3–5 dermatomes	10 days before the rash, weakness of the left arm limited to muscles controlled by the C5 myeloma		T2-weighted MRI		
[20]	73-year old man	Right shoulder pain and herpes zoster eruptions over the C5 dermatome	Two days later, he found it impossible to lift up the right arm				
[21]	A 48-year old female	Rash and vesicles over her left C5–7 dermatomes	Weakness in the left deltoids and biceps muscles, and a diminished left biceps reflex; dyspnea with paradoxical abdominal wall movement		Chest CT normal, MRI-hyperintensity in the left anterolateral aspect of the spinal cord at C5 level	1000 mg valacyclovir orally three times daily for 7 days.	The patient's pain resolved three months later, and the patient underwent outpatient follow-up for 2 years without further complications
[22]	A 72-year old female	Burning pain and rash in the left shoulder and its weakness	Hyperalgesia skin in left C4–T2 dermatomes, left shoulder abduction weakness	EMG-denervation in left biceps, deltoid, brachioradialis and C5–6 paraspinal muscles; sensory and motor nerve-conduction, and somatosensory evoked potentials are normal	MRI of cervical spine-degenerative changes with foraminal stenosis at C3–T1	750mg/d famciclovir per os, cervical epidural blocks with 20mg triamcinolone twice during 4 weeks, 450mg pregabalin and 10mg nortriptyline, physiotherapy	After 2 months, pain and weakness were significantly retracted
[23]	88-year old man with corticosteroids in therapy because of polymyalgia rheumatica	Rash in the right C3–5 dermatome	Paresis in the right shoulder 2 days after the rash			Oral valaciclovir, acyclovir iv after paresis and methylprednisolone	Paresis has gradually improved

Literature	Demographics, medical history	Subjective complaints	Neurological impairments	EMG findings	Other tests	Treatment	Course/Outcome
[24]	59-year old-female with carcinoma mammae dextri and lung metastasis, chemotherapy and radiotherapy	Pain and rash in whole right arm and scapula	Patient was able to adduct shoulder, flexor and extensor wrist and passively extend elbow	EMNG-low amplitude action potentials in left superior radial and median, SNAPs and MUAPs in left deltoid muscle	Positive direct fluorescent antibody test for VZV, neck MRI-C4-C5-C6 levels protruded disk	Acyclovir 10 mg/ 8 hours i.v. for 7 days	Motor activities recovered after 5 months with physiotherapy but postherpetic neuritis had a poor decrement

Table 1.
List of studies that reviewed herpes zoster infection and motor paresis of only upper limbs.

Literature	Demographics, medical history	Subjective complaints	Neurological impairments	EMG findings	Other tests	Treatment	Course/outcome
[25]	#1: 89-year old man, transient facial weakness 1 year earlier, conjunctivitis 6 months earlier	Pain and rash in right thigh and knee	Weakness and atrophy in right thigh, decreased sensation; reflexes diminished in knees and ankles	Denervation in <i>M. quadriceps</i> , tibialis anterior, peroneus longus and gastrocnemius	X-ray: degenerative changes in LS spine	Physical therapy, galvanic electrical stimulation	Incomplete recovery after 3 months
	#2. 44-year old female	Pain and rash over right distal arm in C7–8 dermatome	Weakness of proximal and distal muscles of right arm	Fibrillations in right upper arm in C8 myotome	Not reported	Physical therapy	Incomplete recovery
	#3. 74-year old woman	Pain and rash in T12-L1 dermatomes	Bulging of right abdomen and decreased muscle tone	Not reported	Not reported	Corset	Not reported
	#4. 58-year old woman, diabetes	Pain in left leg and rash over S1–2 dermatomes	Weakness in left knee extensors, ankle dorsiflexors and plantar flexors; reflexes absent in left leg	Not reported	Not reported	Not reported	Able to walk after 5 weeks
[26]	#1. 71-year old female	Rash along right ulnar border of forearm and hand	Weakness in forearm and hand muscles	Not reported	Not reported	Physical therapy	Return of strength but impaired fine movements
	#2. 76-year old female	Rash over right shoulder and arm	Weakness in complete right arm, reflex absent in biceps	Not reported	Not reported	Physical therapy	Full recovery except in deltoid muscle, neuralgia over 3 years
	#3. 83-year old female	Pain and rash over right shoulder	Weakness in deltoid, biceps; reflexes absent in biceps	Not reported	Not reported	Hydrotherapy, exercises	Weakness in deltoid and biceps; neuralgia over 8 months
	#4. 85-year old woman	Pain and rash in left shoulder	Weakness in deltoid, supraspinatus biceps; reflex diminished in triceps	Not reported	Not reported	Physical therapy	Incomplete recovery, residual neuralgia died after 7 months

Literature	Demographics, medical history	Subjective complaints	Neurological impairments	EMG findings	Other tests	Treatment	Course/outcome
	#5. 73-year old man	Pain and rash in right shoulder and in upper arm	Weakness in shoulder with deltoid fasciculations	Not reported	Not reported	Intensive physical therapy	Full recovery after 7 months
	#6. 74-year old woman	Rash over left thigh	Weakness of hip flexors, adductors, knee extensors	Not reported	Not reported	Not reported	Full recovery after 4 months
	#7. 73-year old man	Rash over left shoulder and upper third of arm	Weakness in left arm	Not reported	Not reported	Hydrotherapy, physical therapy	Full recovery
	#8. 81-year old female	Pain and rash over C1–7 dermatomes	Weakness of right serratus anterior, scapula winging	Not reported	Not reported	Intensive physiotherapy	Full recovery in arm, residual pain after 5 months
	#9. 75-year old female	Rash of outer part of right arm	Weakness in shoulder flexors and abductors, and in elbow flexors	Not reported	Not reported	Intensive physiotherapy	Full recovery after 5 months; some pain persisted
[27]	#1. 73-year old female	Rash in right C4–7 dermatomes; segmental severe paresis in C6, 7, 8		Denervation	CSF normal; myelogram normal	Supportive treatment	Full recovery after 7 months
	#2. 78-year old female, diabetes	Rash in right C5–7 dermatomes	Moderate weakness in C5–7 myotomes	Denervation	CSF normal; myelogram normal	Supportive treatment	Full recovery after 9 months
	#3. 67-year old man	Rash in left C5–6 dermatomes	Moderate weakness in C5–6 myotomes	Denervation	Not reported	Supportive treatment	Full recovery after 3 months
[28]	#1. 84-year old man	Pain and rash in right L2–3 dermatomes; impaired sensation in L2–3 dermatomes	Weakness in quadriceps and hip adductors, and flexors; reflexes absent in knee	Fibrillations in hip flexors, vastus medialis	Not reported	Not reported	No recovery, died 6 years later

Literature	Demographics, medical history	Subjective complaints	Neurological impairments	EMG findings	Other tests	Treatment	Course/outcome
	# 2. 66-year old man	Rash and pain in left shoulder and arm in C5 dermatome	Weakness in deltoid and spinatus muscles	Fibrillation, polyphasia and reduced interference patterns MUAP	Not reported	Not reported	Complete recovery after 4 months
	#3. 85-year old female	Rash, pain and impaired sensation in left in C4–5 dermatomes	Weakness in deltoid, spinatus, biceps; reflexes absent	Fibrillations and reduced interference pattern in deltoid	Not reported	Not reported	Minimal weakness after 4 years, residual neuralgia
	#4. 83-year old. female	Pain in outer part of right arm and digitis III-V, rash on posterior forearm and digitis	Weakness in biceps, in triceps, fingers, hand intrinsic; absent reflex in triceps, depressed in biceps, supinator	Fibrillations polyphasia and reduced interference patterns, motor median velocity reduced; absent median sensory neurogram	Not reported	Not reported	Incomplete recovery of hand after 1 year, full recovery in triceps wrist extensors
	#5. 64-year old man	Pain in right shoulder, rash in C5 distribution	Weakness in deltoideus, supraspinatus; impaired sensation in C5 dermatome; reflexes absent in whole arm	Fibrillations in deltoid, moderately reduced interference patterns in deltoid and supraspinatus	Not reported	Not reported	Full motor recovery after 2 years
	C#6. 52-year old female	Pain and rash in left arm (C5–6 distribution); numbness in left thumb	Weakness in left deltoid, spinatus, biceps; reflexes absent in biceps, supinator	Reduced interference pattern in left deltoideus with polyphasic units	Not reported	Not reported	Incomplete recovery after 7 months
	#7. 77-year old man	Pain in right groin, rash in anterior and medial thigh	Weakness in hip flexors, adductors, knee extensors; reflex absent at knee	Fibrillations in thigh muscles, reduced patterns, polyphasic units	Not reported	Not reported	Full recovery after 4 months

Literature	Demographics, medical history	Subjective complaints	Neurological impairments	EMG findings	Other tests	Treatment	Course/outcome
	#8. 73-year old man	Pain around knee, rash in medial aspect of left thigh	Wasting and moderate weakness in quadriceps; reflex diminished at the knee	Fibrillations slightly reduced interference pattern, polyphasic units	Not reported	Not reported	Full recovery after 4 months
	#9.69-year old man	Pain in right axilla, rash in medial arm and medial aspects of two fingers	Weakness in hand intrinsics, sensory impairment in C8, T1 and T2 dermatomes; absent reflexes	Fibrillations polyphasia and reduced interference pattern, reduced motor velocity in ulnar nerve, absent sensory neurograms	Not reported	Not reported	Marked wasting and weakness in thenar, hypothenar, and intrinsic muscles after 1 year
[29]	#1. 77-year old man	Pain and rash in left shoulder	Weakness in shoulder, biceps, triceps, and wrist extensors muscles	Denervation in deltoid and biceps, reduced MUAP recruitment	Routine lab normal; CSF increased protein, normal cell count; VZV antibodies IgG positive IgM negative; cervical spine MRI normal	Valacyclovir 3 g for 7 days, Acyclovir iv 750 mg for 7 days, Methylprednisolone iv 500 mg for 3 days, Prednisol 60 mg and tapering	Full recovery after 1 year
	#2. 57-year old man with diabetes	Pain and rash over right wrist and groin unable to walk	Weakness in right hip, thigh muscles, ankle dorsiflexors, patellar reflex diminished	Denervation in iliopsoas, quadriceps, tibial, F waves reduced in frequency	Blood tests normal; CSF increased protein and cell count; VZV antibodies IgG and IgM positive; lumbar spine MRI normal	Acyclovir 750 mg for 7 days, Acyclovir iv 750 mg for 7 days, Methylprednisolone iv 1000 mg for 3 days, Prednisolone 60 mg	Full recovery after 3 months
	#3. 65-year old female	Pain and rash in left shoulder and arm C5–6 dermatomes	Weakness in shoulder, reflexes diminished	Reduced interference with denervation in deltoid and C5 paraspinals muscles	Cervical spine MRI normal	Valacyclovir 3 g	Marked recovery after 3 months
[11]	#1.84-year old man with myelodysplastic syndrome	R C5,6	Weakness in C5,6 and atrophy	Denervation, polyphasia, normal conduction velocity			Moderate recovery after 6 months

Literature	Demographics, medical history	Subjective complaints	Neurological impairments	EMG findings	Other tests	Treatment	Course/outcome
	#2. 85-year old female	Pain and rash in left C5	Weakness and atrophie in left C5,6 distribution	Denervation, polyphasia, normal conduction velocity			Poor recovery after 1 year and 7 months
	#3. 79-year old female	Pain and rash in right C 5,6	Weakness in 5, 6 distribution	Denervation, polyphasia			Moderate recovery after 2 months
	#4. 67-year old female	Pain and rash in right C5,7 dermatome	Weakness in C5–8	Denervation, polyphasia			Good outcome after 6 y + 8 m
	#5. 82/F	Pain and rash in dermatome L1-S2 bilateral	Weakness in projection L1-S1 bilateral				Moderate recovery after 3y + 8 m
	#6. 80-year old man	Pain and rash in left C6,7	Weakness in left C5-Th1				Good recovery after 1y + 8 m
	#7. 76-year old female	Pain and rash in right C6,7 dermatome	Weakness in C6-Th1 distribution				Good recovery after 7y
	#8. 83-year old male	Pain and rash in right C8-Th1 dermatome	Weakness in C7, 8 distribution				Good recovery after 5y + 9 m
	#9. 7 year old female	Pain and rash in right L4-S1 dermatome	Weakness in right L1, S1 distribution				Good recovery after 5y + 4 m
	#10. 72-year old female	Pain and rash in right C5–7 dermatome	Weakness in right C5-Th1 distribution				Moderate recovery after 2 years and 10 month
	#11. 43-year old male bone marrow transplantation	Rash and pain in right C8-Th1 dermatome	Weakness in C5-Th1 distribution				Uncertain 6y + 8 m
[30]	#1. 69-year old female with diabetes	Pain and rash in right arm, rash over face	Weakness and impaired sensation in shoulder, reflexes diminished in right arm	Not reported	Not reported	Steroid, procaine, physical therapy	Almost full recovery

Literature	Demographics, medical history	Subjective complaints	Neurological impairments	EMG findings	Other tests	Treatment	Course/outcome
	#2. 67-year old man	Pain and rash in low back and right leg in distribution of the sciatic nerve	Weakness in right hip flexors; knee jerk absent	Not reported	Not reported	Paravertebral sympathetic block	Unknown
[31]	#1. 63-year old man	Pain and rash in right shoulder, arm, and hand	Weakness in shoulder, elbow flexors, extensors, in hand muscles; reflexes absent	Denervation in hand, motor amplitudes decreased, velocity normal; absent sensory neurograms	Complement fixing for antibodies VZV in sera was elevated	Physical therapy	Significant recovery except hand intrinsic
	#2. 80-year old woman	Pain from left knee to foot, rash in L5-S2 dermatomes, urinary frequency and incontinence	Weakness in knee flexors, ankle flexors and extensors; reflexes in ankles absent	Not reported	CSF: hyperproteinorachia	Not reported	Incomplete recovery: foot drop and urinary retention remained
[32]	15 patients (9 females and 6 males, mean age 66 years, range 48–80) with rheumatoid arthritis in 3, lymphosarcoma in 1, and lymphatic leukemia in 1	Pain-to-rash interval 2–3 days in 5 patients, 4–6 days in 6, 7 days in 2, unknown in 2; Rash-to-weakness interval < 10 days in 1 patient, 10 to 28 days in 12, 42 days in 1, unknown in 1 (similar in upper and lower limbs)	Distribution of motor paresis: C5–6 in 5, C5–7 in 1, C7–C8–T1 in 2; L3–S1 in 7, L3–S1. Weakness severe in 10 patients, moderate in 3, mild in 2; sensory abnormalities in half of the patients; reflexes diminished	Denervation in 12 patients	Increased protein and cell count in CSF of one patient	Not reported	Full recovery in 11 patients (5 arms and 6 legs). Mean recovery time in arms 9 months, 7 months in legs. 2 improved arms and 1 in legs. Postherpetic neuralgia in 3 patients
	#1. 70-year old man	Pain and rash in C5 myotome	Not reported	Not reported	Not reported	Not reported	Marked recovery
	#2. 56-year old man	Pain and rash in L3 myotome	Diminished knee reflexes	Not reported	Not reported	Not reported	Marked recovery
	#3. 59-year old man	Pain and rash in C5 myotome	Absent reflexes	Not reported	Not reported	Not reported	Full recovery

Literature	Demographics, medical history	Subjective complaints	Neurological impairments	EMG findings	Other tests	Treatment	Course/outcome
	#4. 70-year old man	Pain and rash in C5 myotome	Absent reflexes	Not reported	Not reported	Not reported	Marked recovery
	#5. 71-year old man	Pain and rash in C5–6 myotome	Absent reflexes	Not reported	Not reported	Not reported	Full recovery
	#6. 67-year old female	Pain and rash in C7 myotome	Not reported	Not reported	Not reported	Not reported	Full recovery
	#7. 91-year old woman	Pain and rash in T1 myotome	Not reported	Not reported	Not reported	Not reported	No recovery
	#8. 65-year old female	Pain and rash in C5 myotome	Absent reflexes	Not reported	Not reported	Not reported	Full recovery
	#9. 72-year old man	Pain and rash in C5 myotome	Absent reflexes	Not reported	Not reported	Not reported	Unknown
	#10. 65-year old man	Pain and rash in L2–3 myotome	Absent knee reflexes	Not reported	Not reported	Not reported	Marked recovery
	#11. 56-year old man	Pain and rash in L5 myotome	Not reported	Not reported	Not reported	Not reported	No recovery
	#12. 76-year old man	Pain and rash in C5 myotome	Absent SJ and BJ	Not reported	Not reported	Not reported	Modest recovery
	#13. 62-year old woman	Pain and rash in L3 myotome	Absent knee reflex	Not reported	Not reported	Not reported	Modest recovery
	#14. 70-year old woman	Pain and rash in L3 myotome	Absent knee reflex	Not reported	Not reported	Not reported	Full recovery
[33]	61 patients (39 men and 22 women), mean age 62 yrs. (range 18–87); lymphoma in 6, chronic lymphocytic	Rash-to-weakness interval in 51 patients: <3 days in 6, 3–6 days in 12, 7–10 days in 14, 11–14 days in 11, 15–	Weakness in upper limbs in 16 (C5 to T1 segments at about equal frequency), lower limbs in 15	EMG in 18 patients (9 of them are within legs): fibrillations present in all affected muscles, MUAPs	CSF proteins and cell count increased in 2 patients	Not reported	Limb recovery full in 55%, marked in 25%; residual pain in 8 patients (4 of them

Literature	Demographics, medical history	Subjective complaints	Neurological impairments	EMG findings	Other tests	Treatment	Course/outcome
	leukemia in 1, diabetes in 3, histoplasmosis in 1	20 days in 5, 21–28 days in 2 patients, 29–35 days in 1	patients (L2 to S1 at about similar frequency); abdominal weakness in 2 patients	decreased in number in 2 with large amplitudes; sensory and motor nerve conduction studies normal in all but 3 cases			are with leg distribution)
[34]	#1. 45-year old woman	Pain in right thigh, rash along the sciatic nerve	Decreased sensation in L2-S1-S2 dermatomes, reflexes diminished; weakness in right ankle dorsi/plantar flexors	7 years later- high amplitude and polyphasia on MUAP	Lumbar/pelvic X-ray and CSF normal	Not reported	Full recovery at 3 months after the first episode; moderate after each of next relapses over 7 years
	#2. 80-year old man	Pain in all right arm, rash over anterolateral part of arm	Weakness in all right arm, reflexes diminished, shoulder atrophy and subluxation of humeral head	Fasciculations, rare action potentials in deltoid, supraspinatus and biceps muscles	Neck and spine X-ray: spondyloarthritic changes	Not reported	Incomplete recovery in shoulder muscles after 1.5 years
[35]	#1. 77-year old woman with hypertension and cardiomegaly	Pain and rash in right thigh, decreased sensation in L1–3 dermatomes	Weakness and atrophy in quadriceps; knee reflex absent	Not reported	Not reported	Analgesics, physical therapy	Full recovery after 3–4 months
	#2. 65-year old man	Pain in left chest radiating in left arm, rash in left C5–6 dermatomes	Weakness in proximal and distal muscles of left arm; reflexes absent in arm	Not reported	Not reported	Symptomatic treatment	Full recovery
	#3. 74-year old female with osteoarthritis	Pain and rash in right shoulder (C5–7)	Weakness in proximal and distal muscles of right arm	Denervation in upper and middle trunks of the brachial plexus	Chest X-ray normal	Not reported	Full recovery after 6 months

Literature	Demographics, medical history	Subjective complaints	Neurological impairments	EMG findings	Other tests	Treatment	Course/outcome
	#4. 67-year old female	Pain and rash in distal right arm, sensory loss in C6–8/T1 segments	Weakness and atrophy in hand muscles, reflexes diminished	Severe median and ulnar neuropathy	CSF increased protein, no cells	Analgesics, physical therapy	Full recovery after 8 months
	#5. 64-year old man	Rash over lower lateral chest on left side, T9–10 dermatome	Weakness in left rectus abdominis and oblique muscles	Denervation in external oblique muscles	Not reported	Mild analgesia	
	#6. 80-year old man with DM, myocardial infarction, CVI	Rash and burning pain over right lower abdomen	Bulging of lateral and anterior abdominal wall	Fibrillations and positive waves in right abdominal muscles with later reinnervation	Not reported	Not reported	Full recovery after 4 months
[14]	58-year old female	Pain over left side of neck, rash over left shoulder, lateral left arm, hand and wrist	Weakness of left shoulder and left deltoid muscle			Splint	After 2 months mass and power of the deltoid had increased
[36]	#1. 53-year old man	Disseminated vesicular rash and general malaise	Developed leg weakness in 2 days unable to stand; facial diplegia; reflexes depressed	Normal in arms and legs		Diagnosis of GBS was made and no specific treatment was given	One year later was totally asymptomatic
	#2. 69-year old man with asthma	Painful rash on right buttock	Bilateral facial and truncal weakness; weakness in legs all reflexes absent, loss of light touch and position sense		Mild cyanosis, reduced lung capacity	Received course of plasmapheresis	5 months later only residual sign of mild reduction of hip power
[21]	48-year old woman	Pain in left arm, rash over the C5 to C7 dermatomes	Weakness in the left deltoids and biceps muscle and a diminished left biceps reflex; dyspnea			1000 mg Valacyclovir orally three times daily for 7 days	After 2 years- without further complications; pain resolved in three months

Literature	Demographics, medical history	Subjective complaints	Neurological impairments	EMG findings	Other tests	Treatment	Course/outcome
[1]	80-year old female, dementia	Pain in left part of neck	Left facial palsy; difficulty walking with left lower limb				Gait was normal after 3 months, but left facial palsy remained complete
[37]	#1. 61-year old man	Painful rash on dorsum of right foot, sensory loss over the lateral right leg	Weakness of all parts of right leg, reduced right ankle reflex	Fibrillation and reduced MUAP in muscles innervated by the distal sciatic nerve	PCR of cutaneous crusted of right foot lesions was positive for VZV		No neurologic follow-up
	#2. 69-year old man	Burning pain in right upper limb	Weakness in muscles innervated by right median nerve (right hand)	Fibrillation potentials and reduced MUAP	MRI of arm enlargement T2 signal within the median nerve with gadolinium contrast	Gabapentin	Incomplete improvement-weakness with residual pain
	#3 83-year old woman	Rash over right upper limb	Weakness of right hand grip	Fibrillation and reduced MUAP in distribution of C7-T1 roots; conduction block in the median nerve			After 11 months moderate residual weakness in median innervated muscles
	#4 55-year old man with migraine, restless legs syndrome	Rash on knee and ankle, pain in left buttock, anterolateral thigh and knee	Left knee stretch reflex absent	Fibrillation and reduced MUAP in left iliopsoas and rectus femoris muscles	MRI enlargement and T2 signal in left femoral nerve		No clinical follow-up
[38]	60-year old man	Pain in right leg, rash in anteromedial part of right thigh	Weakness, atrophy and fasciculation of right quadriceps; right knee reflex absent	Reaction of degeneration in the right quadriceps femoris		Thiamine hydrochloride 10 mg. three times a day orally, heat and electrical stimulation	After 3 months incomplete recovery with atrophy of the thigh and fasciculations
[39]	#1. 71-year old man	Pain on right side of chest weakness in both leg and right hand	Deep reflexes brisk			Physiotherapy	3 months later almost full recovery

Literature	Demographics, medical history	Subjective complaints	Neurological impairments	EMG findings	Other tests	Treatment	Course/outcome
	#2. 58-year old man	Rash left side of neck and right upper arm	Weakness in both legs and right arm; reflexes absent in all limbs	Fibrillation potentials affecting muscles of right limb	Velocities affecting in right median and popliteal nerves	Physiotherapy, tetracycline	After 11 months little residual deficit
[10]	#1. 47-year old man	Rash in right shoulder and anterolateral arm	Weakness in right C5–6 myotomes	Denervation in C5–6 distribution			Recovery in 3 months
	#2. 70-year old female with DM	Rash in right lateral arm and forearm	After 20 days weakness in right C5–7 myotomes	Right brachial plexopathy with denervation	Hyperintensity in spinal dorsal horns at C4–5		No recovery after 2.0 years
	#3. 63-year old male with DM	Rash of the right foot and a right L5-S1 plexopathy	Weakness in right L5-S1 myotomes				No recovery after 1.8 years
	#4. 80–90-year old with DM	Rash in neck first	After 22 days right C8 myotome weakness	Denervation in right plexus brachialis			No recovery after 1.9 years
	#5. 87-year old male with DM	Rash in right lateral arm and forearm	After 14 days right C6–8 myotome weakness	Denervation in right C6–8 distribution	Increased signal in the C6–8 nerve roots		No recovery 1.0 year
	#6. 60-70-year (nn gender)	Rash in right buttocks and lateral calf	Weakness in right L5 myotome	Right L5 radiculoplexopathy with denervation			Partial recovery after 1.0 year
	#7. 61-year old male	Rash in left thumb, index finger and forearm	After 15 days weakness in left C6–8 myotomes	Left C7 radiculopathy with denervation	Increased signal in median and radial nerve on MRI		No recovery after 0.5 year
	#8. 80-year old female	Rash in right shoulder, anterolateral arm and thumb	Weakness in right C5 myotomes	Denervation in right C5 distribution	Increased signal in the C5 nerve roots on MRI		Partial recovery after 0.5 year

Table 2.

Lists of studies that reviewed herpes zoster infection and motor paresis of arms and legs.

3.1.1 Lower limb involvement

There are 43 presented patients with isolated segmental zoster paresis of one leg in the total of 26 previously published papers. Nine of these papers present only zoster paresis of the lower limbs, while the rest of them describe affection of arms and torso, also. According to available information, mean age of this group of patients was 64.19 ± 15.28 , and the patient group was dominated by males (20/12).

From medical history, these patients had: diabetes mellitus (4 patients), lymphatic leukemia [11], ulcerative colitis [11], myelofibrosis [11], renal failure [11], hypertension arterialis [43], dementia [11], restless legs syndrome, and chronic low back pain [11].

Almost all patients had weakness in one leg; but 3 of them developed weakness in both legs.

In most cases, proximal muscles were affected (in 13 patients); then in much lesser number, distal muscles (6 patients) were affected; and only 4 of them had developed entire limb weakness.

Muscle atrophy was seen in 3 patients in this group (in *M. quadriceps*).

With regard to other complications, 2 patients developed incontinency, 1 urinary retention, 1 ileus, and 2 abdominal wall weakness.

Denervation has been the most common report (in 18 patients) among patients with electromyoneurography performed; reduced interference pattern was found in 12 patients and polyphasia was present in 4 patients.

Laboratory is sporadically performed in these patients: ELISA for HZV in sera done in 2 patients and were positive in IgG and IgM fraction in both of them, and in the third patient, performed VZV complement fixation was positive, also.

A lumbar puncture was done in a small number of patients [44, 45]: cerebrospinal fluid (CSF) was normal in two cases, but in the other three patients, hyperproteinorachia was discovered.

The patient with flaccid paraparesis had elevated lymphocytes and hyperproteinorachia in cerebrospinal fluid, while PCR for VZV was positive in this case.

MRI of lumbar spine performed in 4 patients did not explain the nature of deficit in these patients, and 2 patients were generally described by degenerative changes, 1 was normal, and in 1 enlargement and T2 signal in the left femoral nerve was found.

The most frequent treatments were physical therapy (4 patients), Acyclovir (2 patients), Methylprednisolone (2 patients), vitamins B1 and B12 [11], paravertebral sympathetic block [11], analgesics, and Gabapentin, lately [11].

There is no information about outcome of the disease for some patients. However, among patients who were followed for a period of time, a majority of them (20 patients) fully or almost fully recovered in the period between 2 and 9 months; 11 patients recovered incompletely; 2 patients did not recover, and 2 patients had with lethal outcome.

3.1.2 Diaphragmatic paralysis

Diaphragmatic paralysis due to phrenic nerve involvement with VZV is described in 24 previously published papers with a total of 26 patients with a mean age of 67.13 ± 11.50 years.

Among comorbidities in this population of patients are rheumatoid arthritis [11], leukemia [11], breast cancer [11], pyelonephritis and nephrectomy, hysterectomy [11], DM [11], hypertension [43], peptic ulcer [11], pancreatitis [11], and bypass [11].

Hemidiaphragmatic paresis is unilateral usually, predominantly on the left side [46], while in one patient, hemidiaphragmatic affection on both sides were recorded.

Although EMNG of phrenic nerve is one of the reliable signs of affection in this nerve, it is rarely performed (1 patient). More often, fluoroscopy is performed when weakness of the diaphragm is suspected (7 patients). Although not a reliable sign of weakness of the diaphragm, X-ray is often done in the case of a suspected weakness of the diaphragm paresis (13 patients).

Phrenic nerve affection is usually followed by dyspnea, but there is a case with hemidiaphragmatic paresis on X-ray, but without visible dyspnea.

To the contrary, there are cases with normal hemidiaphragm position on non-CT chest, when dyspnea is present clinically.

Half of the patients [47] did not recover after significant a follow-up period (1 year and more). Partial recovery was seen in significantly smaller number of patients [48], while complete recovery was present in the fewest number of patients [42].

In most cases, the type of treatment of these patients was not mentioned: Acyclovir in 2 patients, Valacyclovir in 1 patient, physical therapy in 1 patient, and topical hydrocortisone in 1 patient.

The incidence of segmental zoster abdominal paresis mimicking an abdominal hernia is relatively rare. After review from 2013 [49] with 36 patients and segmental zoster paresis of abdominal muscle (14), 8 papers with 11 patients with this problem have been published.

Their mean age (66.5 years) is not much different from the average age of the patients in the review paper from 2013 (67.5 years).

As in the review paper, the predominant level of abdominal involvement of herpes zoster was Th11.

It is the most important to exclude organic disease of the abdomen in the case of abdominal herniation when beneficial are ultrasound or CT abdomen showing normal results.

This is particularly relevant when the abdominal herniation is complicated with, for example, ileus, which is described in 1 patient.

The presence of denervation potentials in EMG of paraspinal (3 patients), or abdominal muscles (2 patients), indicates the involvement of the abdominal musculature, which separates EMG as well as a particularly useful diagnostic method in this case.

Prognosis of these patients is generally good, and there is full recovery in almost all of them in just few months [42, 43, 50].

Acyclovir is rarely used as a therapy in these patients (2 patients).

4. Discussion

Increasing rate of herpes zoster infection with increasing age particularly after age 50 years can be explained by natural decline in cell-mediated immunity to VZV with age [51]: the mean age of patients with the most frequent segmental paresis was for arms 68.56 ± 11.97 years and for legs 64.19 ± 15.28 years.

Healthy people can get HZ [31], although immunocompromised individuals are known to be at increased risk of reactivation and VZV infection [52].

The most immunocompromised patients with zoster paresis have a coexisting malignancy, diabetes mellitus, and chronic steroid therapy [53]: 7 patients suffering from lymphoma and 2 with carcinoma mammae in group with arm segmental paresis and 1 patient with segmental paresis of leg had lymphatic leukemia; as per 4

patient in each group and 1 in group with diaphragmatic paresis suffered from DM and as per 4 patient in both groups of patients with limb segmental paresis on chronic steroid therapy because of autoimmune disorders.

In clinical presentation of HZ infection, pain usually precedes the onset of the rash, and most patients have skin lesions that develop within 7 days of onset of pain [32].

Motor palsy is usually segmental, with abrupt onset reaching its maximum within a few hours [31], corresponding to the dermatomes with cutaneous lesions [18]. Interval between skin eruptions and onset of muscle weakness is generally about 2 weeks in cases with developing segmental paresis [54], but there are some reports of weakness and rash developing simultaneously [55]. With reference to the literature, maximal rash-to-weakness interval in patients with segmental limb paresis was 19 days [37] although there are different experiences. Variations in rash-to-weakness interval is best illustrated in a study of 51 patients: <3 days in 6 patients, 3–6 days in 12, 7–10 days in 14, 11–14 days in 11, 15–20 days in 5, 21–28 days in 2, and 29–35 days in 1 [33]. A delay of 4.5 months has been documented in a patient with diaphragmatic paralysis [56], when the average minimum duration of weakness was 193 days [57]. The fact that the phrenic nerve is a motor nerve and is the longest in the body is the explanation for such a long period of time required for the development of paralysis of phrenic nerve.

Limb involvement by segmental zoster paresis is seen from 0.5 to 0.8% of all patients with cutaneous zoster [10, 11].

Upper extremity involvement is the most common region of extracranial zoster paresis involvement. There are a total of 101 patients with segmental paresis of upper limbs in recently published papers: 55 women and 45 men (**Tables 1 and 3**).

Segmental zoster paresis of the legs present in less than half the number (43 patients with leg involvement) dominated by males (20/12) (**Tables 2 and 3**).

Phrenic nerve affection was described in 26 patients (**Table 4**).

Among patients with limb paresis, proximal muscle involvement usually predominates (C5, 6, 7 or L2, 3, 4). The most commonly affected muscle is deltoid in upper limbs [78].

Besides weakness in upper limbs affected by segmental zoster paresis, in 9 patients, muscle atrophy was detected and in 3 patients in group had leg affection (in *M. quadriceps*).

It is important to recognize severe muscle weakness and atrophy in herpes zoster paresis of limb because it can be so severe to cause marked dislocation of the joint. Because of that, except pain medication, treatment for segmental paresis includes exercise that may prevent muscle atrophy and contractures [17].

Risk of postherpetic neuralgia and pain after 3 months of HZ infection increased and occurs in 8–70% of patients with HZ. People above 50 years are 15 times more likely to develop this complication [79].

In studies involving a larger number of patients with segmental zoster paresis, postherpetic neuralgia persisted in 2 and 6.6% [32, 33].

Among the patients monitored over several months and multiyear period, 13 patients with segmental zoster paresis of arm and 6 patients with paresis of leg have reported pain as the postherpetic neuralgia type (**Tables 1–3**).

The clinical diagnosis makes pain followed by rash and by weakness at the end. Once the rash appears, diagnosis of HZ can be made and laboratory confirmation is not always required.

Some patients may have zoster sine herpete, and it is zoster infection without vesicular eruptions. In making this diagnosis benefit is from varicella zoster virus antibodies in sera or cerebrospinal fluid [13]. In rare cases with herpes sine herpete, cases with prolonged period between rash and muscular weakness and cases with

Literature	Demographics, medical history	Subjective complaints	Neurological impairments	EMG findings	Other tests	Treatment	Course/outcome
[58]	40-year old women; in contact with a child with chicken pox	Rash on left buttock, burning pain in lower back, hip, and left leg	Moderate weakness in left ankle plantar flexors	Normal	Blood and CSF normal, chest and spine X-ray normal	Intrathecal Methylprednisolone, analgesics, bed rest, sodium iodide and oxytetracycline i.v.; hydrocortisone ointment for rash	Complete motor recovery after 9 months
[59]	20-year old man, chicken pox at age 7	Numbness in left foot; pain and rash over left gluteal region	Weakness in left ankle dorsiflexors	Not reported	Not reported	B1 and B12 injections	Full recovery after 2 months
[60]	31-year old man, diabetes, end stage renal failure with maternal renal allograft, autonomic neuropathy, blindness	Rash and pain in right lower back, urinary retention, weakness in right leg, diminished sensation in lumbar and sacral segments	The right ankle plantar flexors (3/5 on MRC scale) and diminished ankle jerk	Not reported	ELISA test on HZV in sera was positive for IgM and IgG, which confirmed the presence of HZ infection	Not reported	Unknown recovery of leg function, some bladder recovery
[61]	57-year old man	Rash over left T8–9 dermatomes, hyperalgesia in both legs, unable to walk, fasciculations in both legs	Flaccid paralysis of both legs, reflexes absent	Not reported	CPK: mild transient elevation; VZV complement fixation positive	Not reported	Full recovery after 3 months
[62]	70-year old woman, with hypertension	Pain in buttocks and legs; rash over left knee, thigh, buttocks; hyperesthesia in left leg; urinary incontinence	Moderate weakness in knee flexors/ extensors, mild in ankle flexors; reflexes absent in left knee, ankle	Diffuse denervation in leg and paraspinal muscles in L3–5 myotomes	X-ray: mild narrowing of L5-S1 disc space; spine MRI: right L4–5 facet joint disease	acetaminophen, oxytocin, bed rest, bupivacaine via L4–5 epidural catheter; parenteral meperidine	Near complete recovery
[63]	78-year old man, idiopathic myelofibrosis receiving cytoreductive therapy	Sudden weakness in both legs; rash in right lower leg involving knee and thigh	Bilateral leg paralysis	Not reported	CSF: increased lymphocytes, monocytes, protein, glucose; PCR on VZV	Wide spectrum antibiotic, granulocyte colony stimulating factor and erythrocyte	After initial improvement, progressive worsening

Literature	Demographics, medical history	Subjective complaints	Neurological impairments	EMG findings	Other tests	Treatment	Course/outcome
					highly positive; X-ray: ileus	transfusions; high-dose acyclovir i.v.	complicated by pneumonia and death
[64]	60-year old man with lymphatic leukemia	Burning pain along the inner aspect of the right lower leg (6/10) and rash, weakness of the right foot	Weakness of the right ankle plantar flexors (3/5 on MRC scale) and diminished ankle jerk	Fibrillations and positive sharp waves in the right gastrocnemius and paravertebral muscles (S1 root); polyphasic MUAP during activation of right foot, nerve conduction was unchanged	MRI of lumbosacral area: degenerative changes; ELISA test on VZV in sera positive for IgM and IgG	Physical therapy and oral gabapentin 900 mg/day	Motor weakness completely resolved about 6 months after the onset of neurologic symptoms but the pain was sporadic but mild
[65]	74-year old with diabetes mellitus, hypertension, and ischemic heart disease	5-day history of paraesthesia starting in the right foot and ascending up the right lower limb	Vesicular rash in the L2/3 region with MRC grading 3/5 in the right hip flexors		MRI: unremarkable	Acyclovir i.v.	Motor paresis that recovered fully with resolution of the rash
[40]	37-year old-female with history of paresis in both legs secondary to spinal cord atrophy and Vogt-Koyanagi-Harada disease and with chronic corticosteroid and azathioprine treatment of ulcerative colitis		Worsening of her baseline residual muscle strength in the right lower limb shortly after herpes zoster eruption	EMG: denervation in L3-L4 and moderate axonal polyneuropathy affecting both lower limbs			

Table 3.
Lists of studies that reviewed herpes zoster infection and motor paresis of only lower limbs.

Literature	Demographics, medical history	Subjective complaints	Neurological impairments	EMG findings	Other tests	Treatment	Course/Outcome
[66]	M, 53-year old	HZ in C3,4 dermatome	dyspnoea				
[67]	80-year old female, nephrectomy because pyelonephritis	Pain and rash over left shoulder and anterior part of chest	weakness of left sholder and proximal muscles, atrophy of supraspinatus and infraspinatus muscles; dyspnoea on left hemidiaphragm	denervation of infraspinatus and supraspinatus	Rtg- paretic left hemidiaphragm		
[44, 45]	56-year old male with peptic ulcer	rash and pain in later aspect of right arm and 3 middle fingers	general weakness of right arm and hand, atrophy of right part of neck, paralysis right hemidiaphragm		X-ray and fluoroscopy-complete paralysis of righth hemidiaphragm		
[68]	77, F rheumatoid arthritis, DM	Rash and pain in C3-5 dermatome	paralysis right hemidiaphragm				
[46]	72-year old female, RA, hypertension	Rash and pain in right C3,4 dermatome	dyspnoea				
[69]	66-year old female	HZ of left C3,4,5	after 12 months dyspnoea		X-ray –elevated left hemidiaphragm; Radioscopy-paralysis of left hemidiaphragm		
[50]	56, male bronchitis	HZ in 1st cervix dermatome	none		X-ray –elevated left hemidiaphragm		
	62-year old female astma	HZ in 1st cervix dermatome	dyspnoea				
	67-year old female	HZ in 1st cervix	dyspnoea				
	57-year old female	HZ in 1st cervix	dyspnoea				

Literature	Demographics, medical history	Subjective complaints	Neurological impairments	EMG findings	Other tests	Treatment	Course/Outcome
[70]	74-year old female	HZ in C3,4	dyspnea				
[71]	80-year old female, hypertension, hysterectomy	HZ in C3-6	Dyspnea, upper limb muscle weakness				
[72]	74-year old male, pulmonary emphysema	HZ in C2-5	deltoid muscle weakness, dyspnoea				
[16]	#2. 60-year old man with lymphatic leukemia	Rash and hypersensitivity in right C5 dermatome	coughing; enlarged liver;	Not reported	Chest X-ray: elevated right hemidiaphragm, paralysis confirmed on fluoroscopy		Complete Recovery after 1 month
[56]	74-year old male	HZ in 1st cervix	cough, dyspnea				not alleviated after 4 month
[73]	79-year old male, hypertension, carotid endarterectomy, bypass	HZ in cervix region	dyspnea, orthopnea				After 12 months not alleviated
[56]	74-year old male	HZ in cervix	cough, dyspnea				After 4 month not alleviated
[42]	A 73-year old woman	herpes zoster of left shoulder and proximal arm	weakness of left shoulder and proximal arm muscles 3 weeks after a diagnosis of herpes zoster	involvement of the C5-6 myotomes and the upper trunk of the brachial plexus	Chest X-ray and electromyographic studies documented paralysis of the left.		One year after muscle strength returned to normal, but radiographic and electrophysiologic findings of diaphragm paralysis were unchanged.

Literature	Demographics, medical history	Subjective complaints	Neurological impairments	EMG findings	Other tests	Treatment	Course/Outcome
[74]	74-year old man	HZ on left shoulder and neck	Left hemidiaphragm paralysis	Axonal changes in left nervus phrenicus	CT and X-ray- left hemidiaphragmatic relaxation	Acyclovir	not allevia after 18 months
[75]		HZ in left side of neck	Dyspnea after 3 months		X-ray- left hemidiaphragm relaxation; Pulmonary functions-restriction		
[76]	54-year old male	thoracic herpes zoster, 1st chest, neck, bilateral shoulders	bilateral diaphragmatic paralysis associated with brachial neuritis, orthopnea, deltoid and biceps brachii muscle weakness		Fluoroscopy		not allevia after 19 months
[42]	73-year old woman	HZ and pain of left shoulder	weakness of left shoulder and proximal arm muscles 3 weeks after HZ was diagnosed and paralysis of left hemidiaphragm	EMG – denervation, reduced recruitment of MUP Phrenic nerve conduction study- denervation without MUP	Chest X-ray- paralysis of the left diaphragm.		Weakness of arm return to normal after one year but X-ray of paralysis hemidiaphragm was unchanged
[21]	A 48-year old female	rash and vesicles over left C5-7 dermatomes	weakness in the left deltoids and biceps muscles, diminished left biceps reflex. dyspnoea with paradoxical abdominal wall movement	CT of chest normal, MRI-hyper-intensity in spinal cord at C5 level		1000 mg valacyclovir orally three times daily for seven days.	Pain resolved three months later, follow-up for 2 years without further complications.

Literature	Demographics, medical history	Subjective complaints	Neurological impairments	EMG findings	Other tests	Treatment	Course/Outcome
[77]	85-year old female breast cancer at age 84, pancreatitis, choleatitis	Rash and pain in her left neck, chest, and arm in C4,5 dermatome			A chest X-ray elevated left diaphragm	Famciclovir for 7 days at a dose of 750 mg per day.	After 14 months dyspnea and no alleviation
[48]	43-year old man	Rash on right neck and apper right hemithorax C3-5	hiccups			On X-ray paralysis of the right hemidiaphragm, HIV +	intravenous acyclovir and admitted to the hospital

Table 4.
Lists of studies that reviewed herpes zoster infection and motor paresis of diaphragmatic paralysis.

dissociation between motor segment and level of dermatomal involvement recommended laboratory confirmation of VZV infection because herpes zoster paresis may be difficult to recognize in these cases.

Possible explanation for zoster sine herpete and for herpes zoster paresis without associated dermatome eruption could be viral spread to anterior roots without corresponding axonal transport through the sensory nerve [6, 12].

Electrophysiologic study of segmental zoster paresis found reinnervation of muscles, absence of fasciculations in involved muscles, and slow motor nerve conduction velocity suggesting motor axon injury rather than anterior horn cells [80].

In electromyoneurography of 58 patients with arm paresis, denervation potential has been described in most cases (51 patients), often associated with reduced pattern and polyphasia of motor unit potentials in most cases (17 patients) and reduced motor or sensor velocity in 4 patients.

Denervation has been the most common report (in 18 patients) among patients who had electromyoneurography of leg paresis; reduced interference pattern in 12 patients and polyphasia in 4 patients were present.

Although EMNG of phrenic nerve is one of the reliable signs of affection in this nerve, it is rarely performed (1 patient).

The presence of denervation potentials in electromyography of paraspinal (3 patients), or in abdominal muscles (2 patients), indicates involvement of the abdominal musculature, which separates EMG as well as a particularly useful diagnostic method in case of abdominal wall zoster paresis (**Table 5**). Because of its self-limited nature and good prognosis, recognition of this complication is important to prevent unnecessary diagnostic studies and procedures, and because of that, abdominal hernia needs no surgery. Thus, electrodiagnostic studies can be effectively used to confirm the diagnosis.

The treatment for segmental zoster paresis includes physical therapy for weakened muscles and protection contractures with graduated exercise. This program may prevent muscle atrophy. Muscle weakness and atrophy can be so severe to cause marked dislocation of the involved joint [17].

In segmental paresis of arm, in most cases, a way of treating these patients is not mentioned. In others, physical therapy was the most common way of treating these patients (24 reported patients) and patients with leg affection, also (4 patients).

Beside physical therapy, for these patients, it is often necessary to provide pain medication, and therefore they are usually given analgesics, opioids, Amitriptyline, Pregabalin, and Gabapentin.

According to some recommendations, initiating treatment with antiviral agents as soon as the rash appears is the key to improve the outcome of herpes zoster. A 3-week course of oral corticosteroids (prednisone 60 mg/day for first week, 30 mg/day for second week, and 15 mg/day for third week) administered with the antiviral medication also has some effect on severity and duration of pain and may decrease the incidence of postherpetic neuralgia [87]. Local, epidural, and sympathetic blocks, if administered within the first 2 weeks of disease, have been reported to decrease pain and the incidence of postherpetic neuralgia [88, 89].

Initiating treatment with antiviral agents as soon as the rash appears is the key to improve the outcome of herpes zoster. As the effect of this therapy on the development of segmental paresis is not known, despite such recommendations, it appears that very small number of patients from the literature with segmental zoster paresis was treated with antiviral medication and corticosteroids. Among the antiviral drugs, Valacyclovir and Acyclovir (in total 13 patients) and corticosteroids in total 5 patients were usually used.

Previous experience in groups with a higher number of patients with segmental zoster paresis shows that the outcome of lower motor neuron involvement is

Abominal wall	Demographics, medical history	Subjective complaints	Neurological impairments	EMG findings	Other tests	Treatment	Course/outcome
[81]	73-year old man with L3 vertebral compression fracture and RA (Prednisolone)	Rash and pain with blisters on his right flank	T12 and L1 segmental paresis caused abdominal wall pseudohernia, scoliosis, and standing and gait disturbance	Denervation in right T12 myotomal muscles, and MUAP markedly decreased		Orthosis Exercise	After 4 months of rehabilitation, marked improvement
[82]	72-year old man	Herpes zoster infection in T11-T12 left dermatomes	Segmental abdominal wall protrusion	Denervation in left external oblique muscle and left paraspinal muscles at T11-T12 level	SSEPs- no response in the left side at T12 dermatome		After 3 months abdominal wall protrusion had completely resolved
[83]			Abdominal wall postherpetic pseudohernia		MRI- increased signal intensity in abdominal wall muscles. Ultrasound- normal		Full recovery
[43]	62-year old male	Cutaneous vesicular eruption on the left side of the abdominal wall	Abdominal distention and paralytic ileus because of a visceral neuropathy		X-rays and CT showed distended small bowel	Acyclovir iv, oral Valacyclovir, Gabapentin 8 d after admission	Full recovery abdominal distention gradually resolved over the next 7 days and pain subsided
[47]	35 articles that described 36 individuals; mean age was 67.5 years. The ratio of men to women was 4:1.	The most affected dermatome was with rash is T11. The left and right sides were approximately equally affected	In 88.9% of the patients, herpetic rash preceded abdominal weakness. The mean latent period from rash to onset of abdominal muscle weakness was 3.5 weeks.		Electrodiagnostic studies confirmed the diagnosis in 95% of tested patients.	Conservative measures	Complete recovery with conservative measures occurred in 79.3% patients, with a mean time of 4.9 months

Abominal wall	Demographics, medical history	Subjective complaints	Neurological impairments	EMG findings	Other tests	Treatment	Course/outcome
[84]	58-year old man	Rash in area 9th to 11th	Protrusion in the right abdominal wall with no pain		Ultrasonography excluded the abdominal wall defect	Oral acyclovir, mecobalamin, and vitamin B1	Disappeared after 2 months
[85]	4 patients	Involvement of posterior rami of spinal nerves in abdominal wall pseudohernia		In 3 patients, EMG of paraspinal muscles showed denervation potentials	MRI-hyperintensity of these muscles on short T1 inversion recovery imaging		
[86]	57-year-old man	Rash and dull squeezing pain	Bulge on his left flank 2 weeks after cutaneous changes				

Table 5.
Lists of studies that reviewed herpes zoster infection and motor paresis of abdominal wall.

relatively good [55]. Motor paralysis is recovered completely or nearly completely in 50–70% of cases usually within 12 months, spontaneously [11]. The time of recovery varies from 1 to 2 years [90]. Only 15% have significant deficit [33].

Among presented patients with known clinical outcomes, complete or near complete recovery is recorded in 9 patients with arm involvement and in 20 patients with leg affection.

Incomplete recovery was reported in 3 patients with arm affection and in 11 patients with leg affection (**Tables 1–3**). Two patients from each group, with segmental paresis of arms and legs, had no clinical recovery. As possible explanation of absence of a complete recovery after motor segmental paralysis caused by herpes zoster is glial scar polyradiculitis evident on MRI [91].

Prognosis in patients with diaphragmatic paralysis is not good because of prolonged reinnervation of diaphragm due to relatively long course of phrenic nerve affection, and the lack of spontaneous recovery is not surprising [74]. It is common for zoster phrenic nerve affection and associated diaphragmatic paralysis to be permanent, but occasionally, recovery has been reported after 7 and 12 months [92].

There are interesting experiences related to Piramat. It may reverse phrenic nerve paralysis in patients with diabetes, but there are no data about its use in patients with zoster-induced diaphragmatic paralysis [90].

It is important to distinguish segmental zoster paresis of abdominal wall from real abdominal wall hernia because abdominal wall hernia is mainly treated by surgery, while segmental zoster abdominal paresis needs no surgery. Ultrasonography or computed tomography (CT) is necessary to do in this case. Electromyographic testing revealed denervation in the affected dermatome and pseudohernia caused by abdominal wall paresis and is of great benefit in defining the problem and recommended in these situations.

5. Conclusion

Segmental zoster paresis is a rare complication of VZV infection. Increasing rate of herpes zoster infection and its segmental paresis is confirmed by the mean age of presented patients—it is above 65 years.

Recognizing segmental zoster paresis is important in the differential diagnosis of muscle weakness of other origin—it is of particular importance to perform electromyoneurography of paretic muscle.

Physical therapy is the most common therapy for these patients, although a lot of patients did not conducted any specific way of treatment.

Prognosis for these patients is generally good, and there is full recovery in most cases, except VZV infection of phrenic nerve and diaphragmatic paresis, where there is no significant recovery of muscle weakness in significant number of patients.

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