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Backpack palsy with long thoracic neuropathy in a 19-year-old female military conscript: case report

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Case Report

Keywords: Rucksack Paralysis, Long Thoracic Nerve Pain, Military Service, Conscript, Pressure Neuropathy, Brachial Plexus

Posted Date: August 7th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10613168/v1

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Additional Declarations: The authors declare no competing interests.

Abstract

Backpack palsy (BPP) is a peripheral nerve injury that occurs when a heavy load compresses or stretches the brachial plexus or surrounding nerves. The occurrence rate of BPP has mainly been researched in military personnel, most commonly affecting younger individuals. BPP can present with scapular winging, paresthesia, numbness, strength and sensory loss, pain, and muscle atrophy. This case report describes dominant-side long thoracic (LT) neuropathy in a 19-year-old female conscript serving in the Estonian Land Forces. Symptoms began about 3 hours during an 11-hour trek while carrying a total load of up to 60 kg and included right-sided sensory and strength loss, pain and soreness in the scapula and chest region, mild breathing difficulties, and reduced functional capability. During the following week, the patient noticed right-sided scapular winging, dropped shoulder, and functional loss in the right upper extremity. The injury remained unrecognized during initial assessments, delaying appropriate evaluation and management. Electroneuromyography two months after injury confirmed right LT neuropathy involving the serratus anterior muscle. Treatment included reduction of shoulder loading, physiotherapy focused on range of motion and pain reduction, repeated follow-up, and gradual strengthening. This case highlights the importance of recognising conditions such as BPP in settings where civilian and military healthcare systems are closely integrated, as timely recognition may facilitate early diagnosis and appropriate treatment.Future research should examine strategies for ensuring appropriate equipment fit to improve the inclusion of women in the military service, particularly as the number of women in the military continues to increase.

INTRODUCTION

Backpack palsy (BPP), also known as rucksack palsy, is a type of peripheral nerve injury (PNI) that occurs when a heavy load compresses or stretches the nerve tissue in the brachial plexus or the surrounding nerves. It can lead to demyelination with or without axonal injury.[1–4] Common manifestations include a winged scapula, paresthesia, loss of strength in the affected upper extremity, numbness, sensory loss, pain and muscle atrophy.[2,3,5,6] BPP often affects the long thoracic (LT), musculocutaneous, axillary, median, suprascapular, radial and/or ulnar nerve. Although BPP occurs predominantly among military personnel, it has also been reported in hikers, mountaineers and manual workers.[3,5,7,8] The highest occurrence rate of BPP is in young soldiers. A recent Dutch military study reported an incidence of 89.6 per 100 000 person-years among personnel younger that 25 years, compared with 28.2 per 100 000 person-years in the overall military population.[1] Higher levels of physical fitness do not appear to reduce the risk of BPP.[5,9] Lower body mass index (BMI) and skeletal muscle mass have been identified as potential risk factors for BPP in both men and women.[10] Women may also face a higher risk of load-carriage related injury during military service, particularly when upper-body strength is lower and the carried load represents a greater proportion of body mass (BM) compared to men.[10–12]

BPP is primarily diagnosed through clinical examination, alongside a nerve conduction study (NCS), an electroneuromyography (ENMG), and/or magnetic resonance imaging (MRI) in order to confirm and characterize the nerve injury.[7,13,14] Reported incidence varies across studies and the condition is likely under-recognized and under-reported. Possible reasons include limited awareness among civilian and military health professionals, pressure on service members to continue training despite symptoms, and the relative rarity of BPP in civilian practice.[1–3,15] BPP may cause prolonged pain, weakness, sensory disturbance and functional limitations, affecting occupational duties and physical activity.[2,5,13,15] As it predominantly affects young military personnel and may reduce readiness for duty, early recognition and prevention are important for military health services.[1–3,16]

Female military personnel remain under-represented in the literature on BPP. To our knowledge, no previous Estonian study has examined BPP, and female military personnel remain under-represented in the available literature. As women constitute a growing proportion of military personnel, research and prevention strategies should consider the unique attributes of women's physiques.[18–22] This case describes dominant-side LT neuropathy in a physically fit 19-year-old female conscript, highlighting delayed diagnosis, continued load exposure, prolonged recovery and possible equipment-related contributing factors.

CASE REPORT

The following section describes the case. Table I provides an overview of the subject's clinical findings and Table II presents the chronological timeline from the beginning of military service. Figure I demonstrates the upper-quarter musculature and injury site at 2 and 10 weeks after injury during bilateral shoulder flexion at 90° and 180°.

Patient information

A 19-year-old female conscript serving in Estonian Land Forces with no chronic illnesses, injuries, musculoskeletal issues, previous damage to the upper limb, or relevant past medical history presented with right-sided (dominant) scapular winging. Before military service, she had trained regularly for approximately 10 years, primarily in long-distance running. During the three months before conscription, she trained for approximately 12 hours per week and participated in two competitions per month. A sports medicine assessment six months before the injury recorded a VO2max = 55.1 ml/min/kg, body fat percentage = 17.2 %, BM = 61.6 kg, height = 170.1 cm, BMI = 21.3 kg/m^2, hand-held dynamometer results: right = 36 kg (dominant), left = 34 kg (non-dominant). A mandatory pre-conscription assessment in April 2025 found her physically and psychologically fit for military service. She began conscript service in July 2025.

Clinical findings

The injury occurred in September 2025, nine weeks after the start of conscript service, during an 11-hour trek as part of a Junior Non-Commissioned Officer Course. The total carried load was reported to beup to 60 kg (including equipment held by hand), approximately 97% of the patient's body mass. The patient wore unidentified combat gear and non-standardized 70–100 L backpack. In addition, they carried some items by hand for approximately 50% of the journey. The trek included a water crossing and difficult terrain. During the journey short breaks were taken, where the backpack's load was removed. The backpack's hip belt broke during the trek, which led to uneven load distribution mainly on the upper-quarter musculature.

Symptoms started at about three hours into the trek and included right-sided (dominant) sensory and muscle strength loss, pain and soreness in the scapula and chest region, mild breathing difficulties and restrictive functional capability with inability to move the hand fully up.

During the following week, in addition to the symptoms developed during the trek, the conscript noticed right-sided scapular winging, dropped shoulder, and sensory and functional loss in the right upper extremity, but did not recognize these findings as an injury. The injury worsened with continued training. The conscript sought medical attention at both civilian and military institutions, but the injury remained unrecognized during the initial assessments, delaying appropriate evaluation and management.

A physical medicine and rehabilitation physician assessed the patient three weeks after symptom onset. Strength and functional testing demonstrated reduced overall and right-hand grip strength and decreased active range of motion (AROM) values on the right side, although the reasons for the overall reduction of strength remained inconclusive as different measuring devices were used. The initial diagnosis favored BPP with possible brachial plexus nerve involvement because symptoms started during heavy load carriage and included scapular winging and shoulder dysfunction. The agreed management plan was to continue military training with a reduced load.

ENMG of the LT nerve and adjacent nerves was performed two months after the injury. The examination demonstrated right LT nerve neuropathy affecting the serratus anterior muscle, with findings consistent with subacute axonal injury and axonal sprouting. The right LT nerve motor response showed reduced amplitude and temporal dispersion following stimulation at Erb's point. Needle ENMG of the serratus anterior demonstrated moderate abnormal spontaneous activity at rest. During voluntary activation, prolonged, polyphasic motor unit action potentials and a mildly reduced recruitment pattern were observed. Although the absolute ENMG parameters remained within normal reference limits, the diagnosis of LT nerve neuropathy was supported by marked side-to-side asymmetry.

MRI of the right shoulder was not provided.

Therapeutic intervention

Therapeutic intervention's timeline with a shortened physiotherapy protocol is presented in Table III. The initial intervention included immediate reduction of shoulder loading (no equipment), a physiotherapy

exercise program focusing on increasing AROM and decreasing pain, and repeated physician and physiotherapy follow-up every two weeks, including videos of the scapula movement every second week. The early phase focused on symptom monitoring, observing the positioning of shoulder and scapula in a relaxed position and while performing shoulder flexion and protraction against resistance, and AROM of the hand during bilateral shoulder flexion and abduction. Medication or other therapy methods, such as electrical stimulation, were not applied.

Because load carriage remained an essential course requirement and alternative arrangements were limited, complete shoulder unloading could not be maintained. The patient continued training with load carriage and, despite some improvement, experienced persistent soreness, pain, nocturnal symptoms, difficulty holding equipment, and physical and psychological fatigue. Three months after the injury, her military service was terminated prematurely because of the persistent impairment, allowing complete cessation of military load carriage.

Following termination of service, the patient continued physiotherapy, with follow-up at least every four weeks. The physiotherapist progressively modified the exercise programme to include resistance-band exercises and light external loads with gradual progression, provided that symptoms did not worsen.

In the later phases of recovery, compound movements, that the patient had performed before, such as barbell bench press, squat, and row, were added to the program at a light weight. Therapeutic massage was provided on three occasions beginning seven months after the injury and was associated with a subjective reduction in local pain and soreness. A trial of transcutaneous electrical nerve stimulation (TENS) was initiated nine months after injury but discontinued early because no initial therapeutic benefit was observed and adverse effects occurred.

Follow-up and outcomes

Repeat ENMG of the LT and adjacent nerves was performed six months after the injury. Motor responses of the right LT nerve remained lower than those recorded on the left. Follow-up needle ENMG of the right serratus anterior showed no spontaneous activity. During voluntary contraction, prolonged, and increasingly polyphasic motor unit action potentials were observed compared with the contralateral side. These findings were interpreted as consistent with ongoing reinnervation and a regenerative phase of right long thoracic nerve recovery. A further ENMG examination after six months was recommended if symptoms persisted or worsened.

DISCUSSION

BPP most commonly affects young military personnel exposed to prolonged carriage of heavy loads. Typical manifestations include scapular winging, upper extremity numbness, and arm AROM restriction. BPP can develop regardless of gender, age, bodyweight, or fitness level. Because BPP may cause prolonged functional impairment and reduce availability for military duties, early recognition, appropriate management, and prevention are important for maintaining operational readiness.[1]

Previous studies have reported similar findings on recovery period, and the association with heavier loads. A Finnish retrospective study of 55 patients with BPP found that heavier loads were associated with more severe neurological impairment.[9] Recovery from long thoracic nerve neuropathy may take between 9 months and 2 years.[23] In a case series of three active-duty military personnel, two patients had LT neuropathies and one had spinal accessory neuropathy following rucksack carriage. All presented with scapular winging and either pain or weakness, and residual symptoms persisted in the patients with LT neuropathy.[2] Even relatively light loads, when carried for short periods, cause measurable changes in nerve function and impair manual performance. These findings highlight the importance of limiting excessive shoulder loading and using appropriately designed load-carriage systems to reduce the risk of BPP and related injuries.[10]

In the present case, several factors may have contributed to the development or persistence of the injury, including the high load relative to body mass, prolonged carriage, failure of the backpack hip belt, delayed recognition, and continued load exposure after symptoms developed. Because the initial assessment occurred in a civilian health care setting, this case highlights the importance of increasing clinicians' awareness of load-carriage related neuropathies such as BPP, which may facilitate earlier diagnosis and management. Continued load carriage and failure of the backpack hip belt may have contributed to prolonged symptoms and delayed recovery. Military load-carriage systems have historically been designed using predominantly male anthropometric data and may therefore fit some female personnel less effectively.[18–21]

The equipment failure during the trek further emphasizes the importance of functional and appropriately fitted load-carriage systems.[2,4,15] Military services may reduce the risk of BPP by ensuring that equipment is individually fitted and suitable for personnel with different body dimensions, including women, [4,5,15,22] and by increasing awareness of load-carriage related neuropathies among service members and health professionals .[2,9,15] Early recognition, prompt reduction or cessation of load carriage, and a training environment that supports reporting and recovery may help prevent prolonged impairment.[5,8,15]

This case report has several limitations. As it describes a single patient, the findings cannot be generalized to broader military populations or used to establish causal relationships. Also, MRI investigation of the right side was not performed during the diagnostic phase, limiting the ability to fully characterize the extent of the injury. Although the case raises relevant questions regarding equipment fit and possible sex-related factors, these observations should be considered hypothesis-generating rather than conclusive.

CONCLUSIONS

BPP can cause prolonged functional impairment, particularly in young military personnel exposed to heavy load carriage. Clinicians should consider this diagnosis when scapular winging, weakness,

sensory symptoms, or restricted shoulder movement develop during or after such activities. As women represent a growing proportion of military personnel, military and health services should strengthen awareness of the condition and ensure that load-carriage equipment is functional and appropriately fitted across a range of body dimensions. Earlier recognition, timely load restriction, and improved equipment assessment may help reduce delayed diagnosis and prolonged recovery.

Declarations

PATIENT PERSPECTIVE

From the patient's perspective, the most challenging aspects were the delayed diagnosis and the expectation to continue load carriage despite persistent symptoms. She felt that limited awareness of military load-carriage injuries contributed to the delay and that better individual equipment fit could help prevent similar injuries.

INFORMED CONSENT

The patient provided written informed consent for publication of this case report and accompanying images/data.

Acknowledgments:

The authors would like to acknowledge the contributions of their colleague Ivar Vähi.

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Tables

Tables 1 to 3 are available in the supplementary files section.

Figures

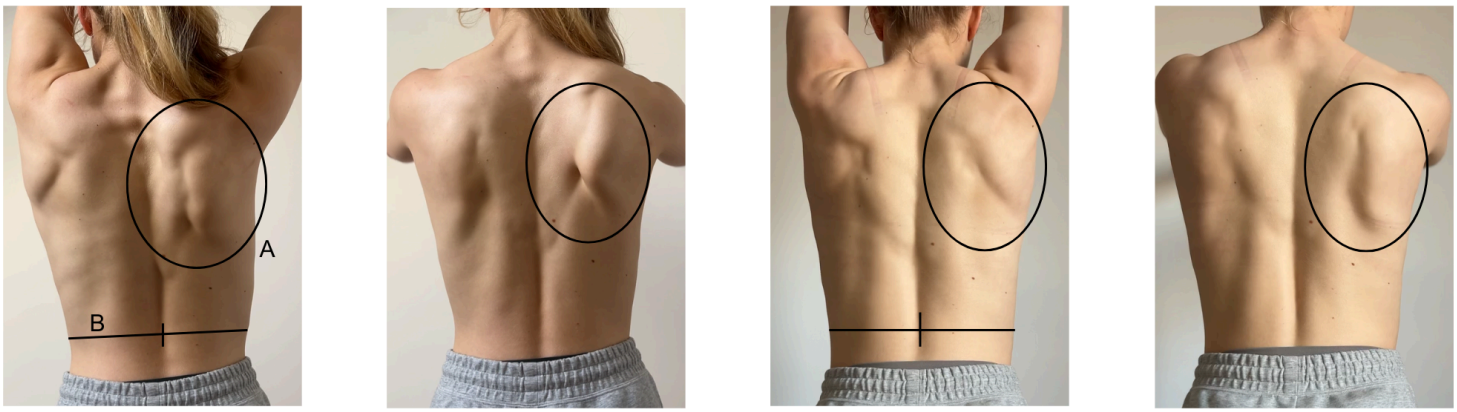


Figure 1

Patient’s upper-quarter musculature and injury site at 2 (photos I and II) and 10 (photos III and IV) weeks after injury during bilateral shoulder flexion at 90° (II and IV) and 180° (I and III). (A) Shows the site of injury and scapula positioning. (B) Shows shoulder and pelvic compensation during overhead arm elevation.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- TABLEI.docx
- TABLEI.docx
- TABLEIII.docx