Clinical Case Report

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Interdisciplinary rehabilitation for a patient with incomplete cervical spinal cord injury and multimorbidity

A case report

Robert D. Vining, DC[a,*], Donna M. Gosselin, PT[b], Jeb Thurmond, DC[c], Kimberlee Case, RN, BSN[b], Frederick R. Bruch, MD, FACP, CPE[d]

Abstract

Rationale: This report describes interdisciplinary rehabilitation for a 51-year-old male recovering from incomplete cervical spinal cord injury (SCI) and multiple comorbidities following an automobile accident.

Patient concerns: The patient was admitted to a rehabilitation specialty hospital approximately 2 months post SCI and 2 separate surgical fusion procedures (C3–C6).

Diagnoses: Clinical presentation at the rehabilitation hospital included moderate to severe motor strength loss in both upper and lower extremities, a percutaneous endoscopic gastronomy tube (PEG), dysphagia, bowel/bladder incontinence, dependence on a mechanical lift and tilting wheelchair due to severe orthostatic hypotension, and pre-existing shoulder pain from bilateral joint degeneration.

Interventions: The interdisciplinary team formally coordinated rehabilitative care from multiple disciplines. Internal medicine managed medications, determined PEG removal, monitored co-morbid conditions, and overall progress. Chiropractic care focused on alleviating shoulder and thoracic pain and improving spinal and extremity mobility. Physical therapy addressed upright tolerance, transfer, gait, and strength training. Occupational therapy focused on hand coordination and feeding/dressing activities. Psychology assisted with coping strategies. Nursing ensured medication adherence, nutrient intake, wound prevention, and incontinence management, whereas physiatry addressed abnormal muscle tone.

Outcomes: Eleven months post-admission the patient's progress allowed discharge to a long-term care facility. At this time he was without dysphagia or need for a PEG. Orthostatic hypotension and bilateral shoulder pain symptoms were also resolved while bowel/bladder incontinence and upper and lower extremity motor strength loss remained. He was largely independent in transferring from bed to wheelchair and in upper body dressing. Lower body dressing/bathing required maximal assistance. Gait with a 2-wheeled walker was possible up to 150 feet with verbal cues and occasional stabilizing assistance.

Lessons: Several specialties functioning within an interdisciplinary team fulfilled complementary roles to support rehabilitation for a patient with SCI.

Abbreviations: ASIA = American Spinal Injury Association, BID = twice daily, DC = Doctor of Chiropractic, mg = milligrams, min = minutes, OT = occupational therapy, PEG = Percutaneous Endoscopic Gastronomy tube, PT = physical therapy, SCI = spinal cord injury, TID = three times daily.

Keywords: chiropractic, integrative care, interdisciplinary care, occupational therapy, physical therapy, rehabilitation, spinal cord injury

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[a] Palmer Center for Chiropractic Research, Palmer College of Chiropractic, Davenport, IA, [b] Crotched Mountain Specialty Hospital, Greenfield NH, [c] Evolution Chiropractic, Keene, NH, [d] Cheshire Medical Center/Dartmouth Hitchcock Keene, Court St, Keene, NH.

[*] Correspondence: Robert D. Vining, Palmer Center for Chiropractic Research, Palmer College of Chiropractic, Davenport, IA (e-mail: robert.vining@palmer.edu).

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1. Introduction

Approximately 70% of patients suffering from spinal cord injury (SCI) experience persistent pain, which can substantially influence cognition, emotional status, activities of daily living, and quality of life.[1] Musculoskeletal pain is commonly experienced by patients with SCI in both acute and chronic postinjury phases, due to factors such as upper extremity overuse, poor seated posture, spasticity, subluxation, and injury.[2] Pharmacotherapy, an essential tool in the rehabilitation and management of patients with complex neurological conditions, is often an insufficient pain management strategy due to the persistence and unresponsiveness of neuropathic pain symptoms, the presence of multiple underlying pain mechanisms, and the limitations of available medications.[2–5]

The limited mobility and sensory capacity experienced by persons with SCI greatly increases risk for pressure ulcer formation.[6] Other common conditions associated with SCI requiring regular surveillance, preventive actions, and/or treatment include bowel and bladder incontinence, depression, and urinary tract infection.[7–9] Balancing patient's need to cognitively and physically engage in rehabilitative activities with pharmacological management, which can cause dependence and secondary side-effects, can be challenging.

Rehabilitative care for patients with SCI requires multispecialty coordination to address the common presence of multiple overlapping conditions.[10,11] This case report describes interdisciplinary care for a patient with an incomplete cervical SCI resulting in injury to the central spinal cord gray matter, otherwise consistent with the diagnosis of Central Cord Syndrome,[12] by a team of providers serving at a rehabilitation hospital. Specialties represented in the interdisciplinary team caring for this patient included primary care (internist and nurse practitioner), physical therapy, occupational therapy, chiropractic, speech therapy, physiatry, therapeutic recreation, assistive technology, registered dietician, nursing, and psychiatry.

2. Case presentation

2.1. Clinical history

A 51-year-old male was admitted to the Crotched Mountain Specialty Hospital, Greenfield, NH, approximately 2 months following a motor vehicle accident, which resulted in multiple cervical spine fractures and incomplete SCI. Injuries included displaced fractures at C3–4 and C6–C7, presumed C3–4 ischemia, C2–C7 edema, C7 spinous process fracture, and C2 transverse process fracture. Three days after initial injury, the patient underwent anterior cervical discectomy and fusion of C3–4 and C5–6. Five days later, the patient underwent a posterior laminectomy and fusion C3–7. Approximately 3 weeks postinjury, a percutaneous endoscopic gastronomy (PEG) tube was placed due to dysphagia. Details describing the clinical rationale for the second fusion surgery and symptom onset relative to PEG placement were unavailable.

Initial hospitalization lasted approximately 4 weeks at which time the patient was transferred to an acute rehabilitation facility for nearly 4 weeks. On admission to the Crotched Mountain Specialty Hospital, the patient met admission criteria for subacute rehabilitation under the primary diagnosis of incomplete cervical SCI.

2.2. Assessment

The patient was classified with central cord syndrome, exhibiting multiple category characteristics of the American Spinal Injury Association (ASIA) classification system.[13]Figure 1 displays functional independence measure scores at admission and again at discharge.[14,15] Initial evaluation of the head, cranial nerves, lungs/thorax, and heart revealed no abnormalities. The patient was cognitively intact and able to interact normally with hospital personnel. Notable abnormal examination findings, comorbidities, and medication regimen at admission are displayed in Table 1. Upper and lower extremity muscle weakness left the patient with very little ability to move independently, requiring assistance for most movements such as turning in bed. No muscle contractures were present. The patient was restricted to a tilt-in-place wheelchair due to severe orthostatic hypotension which prevented maintaining an upright position.

Severe functional capacity limitations, including profound trunk and extremity weakness, absent proprioception in upper and lower body, shoulder pain, and orthostatic hypotension, were attributed to residual tissue damage and edema from the spinal cord injury and 2 subsequent fusion surgeries. The patient wore a hard cervical collar and required mechanical lift assistance to transfer to and from his wheelchair. The patient's bilateral shoulder pain was pre-existing, attributed to degenerative joint disease, for which he was classified with a disability several years prior. Other co-morbidities present at admission were depres-

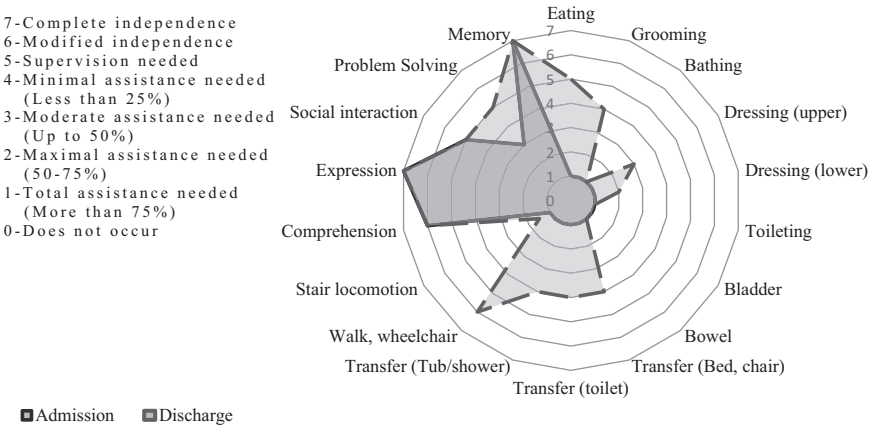

Figure 1. Graphical depiction of functional independence measure scores at admission and discharge.[14,15]

Table 1

Initial examination/status upon admission for subacute rehabilitation.

Medical exam findings	Physical and occupational therapy findings	Concurrent conditions	Medications
Normal personal interactions without obvious distress	Left upper extremity muscle strength 3–4/5 indicating capable of producing movement against gravity or with mild resistance for shoulder abduction, flexion, elbow flexion and extension, wrist flexion, wrist internal and external rotation.	Disability status due to bilateral shoulder degenerative joint disease	Docusate sodium 100 mg BID, Laxative
Cranial nerves intact	Right upper extremity strength 4/5 for shoulder abduction, flexion, elbow flexion, and 5 (normal) for wrist extension	Attention deficit hyperactivity disorder	Famotidine 20 mg BID, Gastroesophageal reflux
Normal cardiac and pulmonary auscultation	Trace strength in triceps bilaterally	Benign prostatic hypertrophy	Polyethylene Glycol (1 packet daily), Laxative
Normal abdomen with percutaneous endoscopic gastronomy tube in place without inflammation	Orthostatic hypotension in any upright position	Gastroesophageal reflux disease	Senna 17.2 mg (bedtime), Laxative
Upper and lower extremity weakness	Difficulty balancing while sitting with weak core strength	Depression	Tamsulosin Hydrochloride 0.4 mg daily, Benign Prostatic Hypertrophy
Bowell/bladder incontinence	Produces only 35–50% of effort required to roll/ turn in bed	Anxiety	Lidodcaine patch 5%, Local anesthetic
Hard cervical collar in place	Dependent on mechanical lift for transferring from bed/chair		Duloxetine 60 mg daily Antianxiety/antidepressant
Mild reduced skin sensation in upper extremities	Reliant on tilt-in-space wheelchair for pressure relief and modulating blood pressure		Enoxaparin Sodium 40 mg daily, Anticoagulant
Moderate to absent skin sensation in lower extremities bilaterally beginning 2 centimeters above the umbilicus	No proprioceptive sense in upper or lower extremities, dependent on vision for position sense		PRN medications
Biceps, brachioradialis, patellar reflex +2 each			Bisacodyl suppository, Laxative
			Acetaminophen 650 mg Analgesic
			Magnesium Hydroxide, Antacid
			Calcium Carbonate, Antacid
			Diazepam 2.5–5 mg TID Antianxiety
			Ondansetron 4 mg/6 hours, Antiemetic

BID = twice daily, mg = milligrams, TID = three times daily.

sion, anxiety, attention-deficit hyperactivity disorder, benign prostatic hypertrophy, bowel and bladder incontinence, and gastroesophageal reflux disease.

2.3. Initial plan of care

Initial plans of care included orthostasis monitoring with abdominal binder and lower extremity compression stockings. A registered dietitian noted a normal appetite and weight. A balanced diet with the goal of weight stabilization was prescribed. The patient was not receptive to dietary education. The patient's oral nutrient intake was also monitored to determine an appropriate PEG tube removal time-point. The internist and nurse practitioner ordered medication and served on the interdisciplinary care team. Occupational therapy (OT) management focused on improving hand/finger coordination and control, feeding, dressing, and brushing teeth. Education regarding strategies and the importance of developing self-functional skills was also incorporated into 1 hour sessions, 5 days per week. Physical therapy (PT) plans included physical and educational training on transfer ability from the wheelchair to a mat using a slide-board. Gradual upright tolerance practice was also used to accomplish the dual goals of sitting fully upright in a wheelchair for 30 minutes and to facilitate upright rehabilitation activities without signs/symptoms of orthostatic hypotension. Physical therapy activities occurred in approximately 1 hour sessions, 5 days per week. The basic rehabilitation schedule by discipline from admission through discharge is reported in Table 2.

Nursing assisted with orthostasis management by implementing the abdominal binder and compression stockings. Wound and infection prevention activities,[16] medication adherence, nutrient intake, and bowel and bladder incontinence were also carried out by nursing professionals. The patient met twice weekly with psychology professionals who provided counseling to help the patient cope with the effects of his SCI.[5,17,18]

The patient received a right shoulder methylpredisolonel/ bupivacaine injection from the physiatrist to relieve symptoms of

Table 2

Rehabilitation intervention schedule by discipline.

Timeframe	Physical therapy	Occupational therapy	Chiropractic	Therapeutic recreation	Rehabilitation technician	Psychology	Nursing
Months 1–4	5 days/week 60 min*/sessions	5 days/week 45 min/sessions	2 days/ week 30 min/sessions	2 days/week 45–60 min/sessions	2 days/ week 45 minutes	2 days/week	7 days/week 12 hours/day
Months 5–10	4 days/week 45 min/sessions	4 days/ week 45 min/session	2–1 days/ week 30 min/sessions	2 days/week 45 min/sessions	4 days/week 45 minutes	2 days/week	7 days/week 6 hours/day
Months 11–12	3 days/week 30–45 min/session	3 days/ week 30 min/session	1 day/ week 30 min/sessions	2–3 days/week 45 minutes	5 days/week 45 minutes	2 days/week	7 days/week 5 hours/day

* min = minutes.

Table 3

Status of key functional abilities during the rehabilitation program.

Functional area	Admission	After 5 months	After 9 months	After 11 months (discharge)
Hand	Unable to pick up or hold a filled cup Unable to hold grab bars	Gross grasp to lift cup with 1 hand Increased left hand pinch strength to unfasten seatbelt Uses upper extremities to assist in pulling to stance with grab bars	Able to grasp laundry wet and dry Better ability to utilize computer Able to hold on to 2 wheeled walker without need for right wrist stabilizer	Grooming: capable of performing with equipment setup Bathing: Could be independent for upper body and maximal assistance for lower body; needed maximum encouragement to self-perform.
Dressing	Dependent on assistance of other (s)	Independent with buttonless short sleeve shirt Requires maximum assistance for lower body dressing	Moderate assistance needed for lower body dressing	Upper body dressing: Independent with short sleeve shirts; minimal assistance needed to don long-sleeves. Lower body dressing: Maximal assistance needed
Supine to sitting transfer	Dependent on assistance of other (s)	Occasional verbal cues needed when sitting on exercise/therapy mat	Sits on mat with verbal cues and increased time Reports decline in ability to sit on edge of bed though at times can perform independently	Minimal assistance needed to transfer to edge of bed dependent on variable muscle tone levels
Bed to wheelchair transfer	Dependent on mechanical lift	Assistance needed for occasional loss of control during squat pivot transfer	Assistance needed for occasional loss of control during squat pivot transfer	Transfers via squat pivot motion with assistance needed only for occasional loss of controlled movement
Walking/Gait	Unable to perform	Platform walker needing minimal assistance to walk >400^^ feet or 122 m Ataxia with decreased weight shift over right lower extremity Floor reaction brace on right Difficulty stabilizing right knee Relies on visual feedback for foot placement	Walking with minimum to moderate assistance with 2-wheeled walker for 100 feet Ataxia (related to poor proprioceptive sense) with decreased weight shift over right lower extremity. Relies on visual feedback for foot placement	Gait with 2 wheeled walker: Highly reliant on visual feedback for foot placement Decreased right weight shift with small step length Occasional verbal cues needed to stabilize right knee during stance phase Able to ambulate 150 feet with verbal cues and assistance for occasional loss of controlled movement or occasional minimal assistance
Sitting balance	Uses upper extremities for seated support	Within normal limits	Within normal limits	Balance is within normal limits
Standing balance	Unable to perform	Relies heavily on visual feedback for all aspects of standing Hip and ankle strategies emerging Occasional protective steps emerging Non-integrated stepping motions require full concentration	Unchanged from prior assessment	Sit to stand with minimal assistance Poor balance in stance due to decreased proprioceptive sense Using ankle and hip balance strategies on left, though not efficient

Minimal assistance: patient able to contribute 75% of total required effort to perform activity remaining effort provided by 1 or more persons.
Moderate assistance: patient able to contribute 50–74% of total required effort to perform activity, remaining effort provided by 1 or more persons.
Maximal assistance: patient able to contribute 25–49% of required effort to perform activity, remaining effort provided by 1 or more person.

impingement syndrome approximately 1 month following admission. Chiropractic care, which became available approximately 2 months after admission, occurred twice weekly for approximately ½ hour. Treatment focused on relieving upper and lower back pain and right shoulder pain attributed to impingement syndrome and chronic strain from wheelchair positioning and transfer difficulty. Manual therapy to the right wrist was also provided to improve mobility and support self-care goals including improving fine-motor skills. Specific treatments included gentle thrust manipulation to the thoracic and thoracolumbar region, mechanical percussion, and stretching to the right hand/wrist/elbow and scapular regions and manual muscle therapy to the cervico-occipital region. At this facility, physical therapists do not perform spinal manipulation/mobilization and the chiropractic physician had more extensive training and experience in manipulative and myofascial therapies oriented toward pain reduction. All treatment plans were derived collaboratively through formal meetings with all care team members.

2.4. Ongoing rehabilitation

After approximately 4 months of rehabilitative care, shoulder and thoracic/lumbar symptoms were downgraded from being described as painful to that of stiffness. Chiropractic treatment, which was primarily focused on reducing these symptoms, was therefore reoriented toward improving upper extremity mobility and strength. Treatment to the right upper extremity included joint mobilization and muscle stretching to support OT goals of improving manually coordinated activities, such as eating, opening prescription bottles, and computer operation.

Table 3 displays key functional status elements at admission, 5 months and 9 months. At 6 months postadmission, the patient was capable of performing a stand-pivot maneuver with minimal assistance. He also operated small handheld electronic devices and self-propelled himself in a wheelchair. By 7 months, the postadmission functional progress had slowed and the patient reported increased stiffness, especially in the lower extremities while trying to ambulate. Evaluation by the physiatrist revealed increased muscle tone rated as 3 on a Modified Ashworth rating scale making passive movement difficult in the right foot, gastrocnemius/soleus, and thigh adductors.[19] Baclofen was prescribed to reduce the abnormal muscle tone and relieve stiffness. Baclofen was prescribed over botulinum toxin as a less invasive intervention, due to patient preference, and because some increased lower extremity muscle tone was providing stability during gait. Botulinum toxin could have negatively influenced mobility by reducing muscle tone too much.

Two weeks following Baclofen administration, lower extremity muscle tone was reduced to a rating of 1 on the Modified Ashworth scale (slightly increased tone with catch and release or minimal resistance at end range of motion). However, 1 month after Baclofen administration, increased muscle tone showed some regression. Periodic urinary tract infections were managed by an internist, nurse practitioner, and nursing staff. Physical, recreational, and occupational therapies modified their rehabilitation focus toward achieving functional independence. Inter-

ventions included pool-based walking strength and coordination training, upper extremity strength and mobility exercises, computer operation training, and performing dressing activities with minimal assistance. The patient also diligently performed self-administered exercise programs prescribed by the physical therapist, chiropractor, and occupational therapist.

Ten months postadmission, follow-up magnetic resonance imaging to assess spinal cord status demonstrated a cystic region consistent with myelomalacia at C3–4, which was an expected finding resulting from the SCI and was consistent with remaining motor and sensory deficits. Approximately 11 months post-admission, the patient was discharged to a long-term care facility with the goal of eventually returning home. Varied aspects of functional status at discharge are included in Table 2 and Fig. 1.

3. Discussion

Each SCI is unique due to the extensive variability of injury possible at many spinal cord levels. In this case, incomplete SCI resulted in mobility limitation of all extremities, widespread sensation loss, bowel/bladder incontinence, and reduced or absent muscle strength in the trunk and all extremities. Shoulder pain, dysphagia leading to PEG placement, 2 cervical fusion surgeries, and back pain complicated the rehabilitation process. The presence of multi-system co-morbidity is common in patients suffering from SCI and a major reason why multiple disciplines are needed to render appropriate care and rehabilitation.[10,11]

This case demonstrates rehabilitation as performed within an interdisciplinary team wherein individual providers exercised an awareness of how their procedures and care goals affected those of other team members and the patient. The presence of chronic pain, with the potential to influence goal setting by constantly altering attention and interfering with other cognitive and emotional functions can frustrate rehabilitative goals.[20] To address this and other challenges, treatment planning occurred via regular discussion of patient status, identifying specialty specific goals, setting rehabilitation benchmarks, which were documented in formal plans. In this case, care coordination occurred formally, during bi-weekly interdisciplinary team meetings, and informally, during the normal interactions of the various providers.

Coordinated interdisciplinary management emphasizing and supporting the care of other providers within a team is designed to augment the benefit for the patient by avoiding redundant and unnecessary care and generating a synergistically positive therapeutic effect. Coordinated management was a factor in the rehabilitation of this patient. For example, chiropractic care addressed spine/shoulder pain and hand flexibility. Reducing shoulder pain and implementing upper extremity exercises has been shown to enhance quality of life and facilitate other rehabilitation activities.[21–23]

Little research has been conducted to elucidate the specific benefits of chiropractic care for persons suffering from SCI. In this case, care was provided to reduce concurrent musculoskeletal pain arising from the thoracic spine and shoulders, which was preventing other rehabilitative activities. Arienti and colleagues[24] reported spinal manipulation, 1 therapy used in this case example was effective at reducing pain in a clinical trial studying patients with spinal cord injuries ranging in severity from ASIA levels A-D. A growing body of literature, including clinical guidelines, indicates nonpharmacological treatments commonly provided by chiropractic providers can be effective for patients with musculoskeletal pain, especially that of the spine.[25–30]

As is common with individuals suffering SCI where rehabilitation progress is measured in small increments over long time-periods, patient mood and frustration can play substantive roles influencing the ability to participate in rehabilitation activities. The patient took advantage of psychology and psychiatric resources to facilitate coping strategies, support well-being, and process concerns related to managing the physical challenges resulting from his injury. Each discipline represented on this interdisciplinary team engaged in patient education, monitored and recorded observations of the patient's emotional status, and reinforced care goals of others when possible. Without a coordinated approach, redundant care and contrasting goals will likely lead to confusion for patient and providers, and impede progress. A health organization dedicated to supporting this level of care coordination is required to facilitate the interdisciplinary process described in this article.

A well-functioning interdisciplinary team is aware of the potential effects each members' care and counsel can produce on the goals and strategies of the patient, other team providers, and the overall rehabilitation plan. In the case presented here, members of each professional group worked collaboratively to support and/or facilitate the care of other team members by adapting methods to avoid redundant therapies and enlist the evaluation and/or treatment of needed specialties.

4. Conclusion

This case describes the rehabilitation management of a patient suffering from incomplete SCI with tetraplegia by an interdisciplinary team. Rehabilitation team members from multiple specialties can fulfill synergistic roles when working collaboratively within the context of a regularly updated comprehensive management plan.

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