Research article

Rehabilitation of people with spinal cord damage due to tumor: literature review, international survey and practical recommendations for optimizing their rehabilitation

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Background/Objectives: People with spinal cord dysfunction (SCDys) due to tumor (benign and malignant) pose enormous rehabilitation challenges. Objectives were: conduct literature search regarding epidemiology, clinical features and outcomes for SCDys due to tumor following rehabilitation, the ideal setting for rehabilitation and practical considerations for rehabilitation; and propose framework and practical considerations for managing people with SCDys due to tumor in spinal rehabilitation units (SRUs).

Design: Survey of rehabilitation health care professionals, consensus opinion from experts and literature search.

Setting: Workshop at International Spinal Cord Society and American Spinal Injury Association combined annual meeting, May 16, 2015, Montréal, Canada.

Participants: Workshop attendees and experts in the rehabilitation of people with SCDys due to tumor.

Outcomes Measures: Reports of services offered to people with SCDys due to tumor, including whether those with benign and malignant tumors are admitted into rehabilitation, any admission criteria used and the rationale for declining admission.

Results: Most respondents (n = 33, 83%) reported that people with benign tumors were routinely admitted for rehabilitation but only 18 (45%) reported that people with malignant tumors were routinely admitted. A range of criteria and reasons for declining admission were given. Evidence from the literature and the opinion of experts support the admission of people with SCDys due to tumor into specialist SRUs.

Conclusions: A framework and practical considerations for managing people with SCDys due to tumor in SRUs are proposed. Patients with tumor causing SCDys should be given greater access to specialist SRU in order to achieve the best outcomes.

Keywords: Delivery of health care, Neoplasms, Rehabilitation, Spinal cord diseases, Spinal cord injury

Introduction

Non-traumatic spinal cord dysfunction (SCDys) is suspected to be more common than traumatic spinal cord injury (SCI) in many developed countries, with the best evidence for this coming from Australia and

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Canada.^{1,2} Of the many causes of SCDys,³ benign and malignant tumors are reported to be among the most common etiologies, accounting for 15–30% of patients with SCDys admitted into spinal cord rehabilitation units (SRUs) that do not discriminate against this etiology.^{4,5} It is expected that with population aging in the coming decades the incidence of SCDys due to tumor will increase dramatically.¹

Despite the evidence that people with SCDys have improved outcomes when admitted to a specialist SRU⁶ many SRUs have a bias against admitting people with SCDys.^{7–9} The bias of SRUs against admitting people with SCDys appears to be particularly strong regarding those people with SCDys due to tumor,^{10,11} although numerous SRUs do admit these patients.^{5,10,12–17}

It is acknowledged that the rehabilitation of patients with tumor presents unique challenges,¹⁸ and this applies especially for those with tumor as the cause of SCDys.^{10,16,19–21} Despite the high proportion of people with tumor causing SCDys there has been relatively little written about these patients in terms of the ideal setting for their rehabilitation or recommendations for rehabilitation teams caring for them.^{10,16,19,20,22} The objectives of this project were: 1) to provide a brief review of the epidemiology, clinical features and outcomes for patients with SCDys due to tumor, 2) to survey participants attending a workshop on the rehabilitation of people with SCDys due to tumor about the admission practices of their SRU regarding these people and the services available for their rehabilitation, and 3) based on evidence from the literature and our expert opinion, propose practical considerations for staff working in SRU when managing people with SCDys due to tumor.

Methods

Literature review

A literature search was conducted (December 2015) using Medline and Embase (1990–2015) for publications regarding the epidemiology, clinical features and rehabilitation outcomes for patients with SCDys due to tumor (benign and malignant). The terms used in the literature search were based on previous recommendations²³ and shown in the appendix. In addition, the reference section of included publications and the personal library of the authors were searched for additional potentially relevant publications. A focus of the literature search was also placed on identifying publications that discussed the ideal setting for the rehabilitation of people with SCDys due to tumor and practical considerations for staff working in SRU when managing people with SCDys due to tumor.

Only publications in English and involving adults were included.

Survey and workshop

A workshop titled ‘*Epidemiology, outcomes and practical principles in the rehabilitation of people with spinal cord damage due to tumor*’, which all authors participated in, was held as part of the 4th combined International Spinal Cord Society and American Spinal Injury Association annual meeting, May 16, 2015, Montréal, Canada. A survey was developed by the authors in an iterative process prior to the workshop that was designed to gather information from workshop attendees regarding whether people with benign or malignant tumors as the cause of their SCDys were admitted into respondents rehabilitation service, any admission criteria used along with rationale for non-admission, and information about the community-based services offered by the rehabilitation service to people with SCDys due to tumor. The survey was based on similar surveys previously conducted of 9 spinal rehabilitation units in different countries²⁴ and of Rehabilitation physicians working in adult neurological rehabilitation inpatient units in Australia and New Zealand in 2014. Attendees at the workshop were given the survey to complete as they entered, with instructions to complete the survey as they took their seats. Consent of survey participants was implicit by their participation (they were informed that the information would potentially be used in a publication). The surveys were collected prior to the commencement of the workshop.

The one and a half hour workshop included presentations on the following:

- Epidemiology, clinical features and outcomes for patients with spinal cord damage due to tumor (GS).
- Practical considerations for spinal rehabilitation units when managing people with spinal cord damage due to tumor (PWN).
- Complications of spinal cord tumors and tumor treatments, and their management (MS).

A 30-minute audience and panel discussion followed the presentations. This highlighted additional challenges and explored other facets of this topic that contributed to informing the areas covered in the next section.

Formulating recommendations for rehabilitation of people with spinal cord dysfunction due to tumor

The formulation of practical recommendations for optimizing the rehabilitation of people with SCDys due to tumor were based on a triangulation approach – using three different methods. The results of the literature search, the discussions that occurred during the

workshop described in the above section and our collective expertise with the rehabilitation of people with SCDys due to tumor (each of us has a minimum of 19 years experience in this field) all informed the development of recommendations.

Ethics

Approval of the local relevant ethics committee was not required for this project. We adhered to ethical research practice in conducting this research.

Results

Literature review

The literature search identified 5 publications that reported on the epidemiology and rehabilitation outcomes of people with SCDys due to tumor and screening the reference section of these and searching the authors' libraries identified 4 additional publications.^{5,10,12–16,25,26} The key findings from these are summarized in Table 1. A number of reports compared people with SCDys due to tumor to those with traumatic SCI and found that the tumor group had a shorter length of stay in SRU, comparable improvement in functional abilities and similar rates of discharge back into the community.^{15,27}

A number of publications reported on the functional outcomes of people with SCDys due to tumor, with the consistent finding that they had a significant functional improvement between admission and discharge.^{5,15,16,26} Compared to people with traumatic SCI, however, their functional improvement was less.^{15,27} In comparison with other causes of SCDys, people with tumor have a trend towards lower functioning on admission and at discharge, and possibly lower overall change in function when compared with the other causes.^{26,28} Most of the literature on rehabilitation outcomes for people with SCDys due to tumor either lumps all tumors together or reports just on metastatic. There are very few that report on rehabilitation outcomes from those with benign tumors.⁵

There are only a few studies on the survival of patients with SCDys due to tumor following rehabilitation, with the reports in the literature indicating a median survival of 3–30 months for those with metastatic tumor^{10,14,29,30} and 11 months for those with primary tumors.²⁹ One study reported that patients spent more than a third of survival time after diagnosis in rehabilitation.¹⁴

In the only study located that assessed the benefits of specialist rehabilitation for people with SCDys due to tumor, 12 people with paraplegia due to tumor admitted to a rehabilitation program that focused on optimizing their outcomes were compared with a historic control

Table 1 Summary of the literature detailing the epidemiology and clinical outcomes of rehabilitation following spinal cord dysfunction due to tumor

	Murray ²⁵	McKinley ¹²	Parsch ¹⁰	Eriks ¹³	Fattal ¹⁴	Scivoletto ¹⁵	Tan ¹⁶	Fortin ²⁷	New ⁵
Year published	1985	1996	2003	2004	2009	2011	2012	2015	2016
Years of the study	12, NR	5, NR	1979–1995	1990–1999	2003–2007	1996–2007	1996–2008	2007–2011	2008–2010
n	27	32	68	97	26	63	108	143	238
Benign vs malignant	0 vs 100%	0 vs 100%	0 vs 100%	0 vs 100%	0 vs 100%	51% vs 49%	34% vs 66%	0 vs 100%	65% vs 35%
Primary vs secondary	19% vs 81%	NR	0% vs 100%	0% vs 100%	4% vs 96%	76% vs 24%	NR	0 vs 100%	NR
Age (years)	55*	61*	54.9*	59*	57*	50.9*	61.5†	66†	50† (benign), 59† (malignant)
Male	NR	56%	44%	53%	81%	49%	62%	53%	43% (benign), 68% (malignant)
Rehabilitation LOS (days)	57.6*	27*	50†	103*	161*	89.9*	47.5†	26†	48† (benign), 30† (malignant)
Discharge home	81%	84%	NR	68%	53%	79%	52%	65%	86% (benign), 70% (malignant)
Pain as problem	NR	66%	NR	NR	NR	NR	NR	NR	NR
Prognosis criteria for admission	>3 months	NR	NR	NR	>3 months	NR	>3 months	NR	Variable (3 months to 1 year) ¹⁷

NR = not reported; LOS = length of stay

* Average; † Median

group of 30 people not admitted to rehabilitation.³¹ The two groups had similar age, level and tumor type, but no other comparison regarding prognostic factors. The authors reported that the rehabilitation cohort had longer median survivals, fewer deaths from SCDys complications, less pain, lower depression scores, and higher satisfaction with life. In addition, they were more likely to become independent with transfers or return home. A follow-up study found that those who received rehabilitation had less pain, were less depressed, higher satisfaction with life, and that these benefits persisted until patients' deaths.¹¹

A number of publications provided guidance on the management of important symptoms and complications during rehabilitation of people with SCDys due to tumor.^{14,19,20,22,32}

Survey

There were 40 workshop participants who worked as health care professionals in rehabilitation who completed the survey. It is estimated that the response rate was close to 100%. The participants worked in a range of countries: Canada (n = 10), Australia (n = 8), The Netherlands (n = 6), USA (n = 5), Italy (n = 2),

Denmark (n = 1), Norway (n = 1), South Korea (n = 1), Taiwan (n = 1), and the UK (n = 1). Four did not specify the country where they worked. The demographic characteristics and professional role of participants, along with the type of services available for patients at their center are shown in Table 2.

The percentage of inpatients with SCDys due to tumor followed up in a SRU medical outpatient or review clinic setting was reported as follows: 1–25% (n = 20, 50%), 26–50% (n = 2, 5%), 51–75% (n = 3, 8%), 76–100% (n = 6, 15%) and unsure (n = 9, 23%). The following outpatient or community services were reportedly available for patients with SCDys due to tumor: cancer rehabilitation specialist (n = 6, 15%), spinal cord medicine specialist (n = 30, 75%), general rehabilitation physician (n = 16, 40%), cancer survivorship physician (n = 6, 15%), other medical specialist (n = 14, 35%), cancer survivorship (non-physician) clinician (n = 3, 8%), physical therapy (n = 31, 78%), occupational therapy (n = 29, 73%), lymphedema therapy (n = 11, 28%), cognitive therapy or psychology (n = 21, 53%), other allied health (n = 10, 25%), unsure what is available (n = 5, 13%).

Most respondents (n = 33, 83%) reported that people with benign tumors causing SCDys were routinely admitted to the SRU where they worked but only 18 (45%) reported that people with malignant tumors were routinely admitted. The reasons given by respondents for people with a tumor as the cause of their SCDys not being admitted to SRU and reported admission criteria for those centers that did admit these people, either formally documented or principles that were generally followed, are shown in Table 3.

Practical recommendations for optimizing rehabilitation of people with spinal cord dysfunction due to tumors

Setting of rehabilitation

The evidence in the literature suggests that people with SCDys admitted to specialist SRUs have better outcomes^{6,8} than those admitted to a general rehabilitation unit because of the improved access to vital services and spinal cord medicine rehabilitation expertise.^{8,33} These findings have been confirmed in studies that focused on people with SCDys due to tumors.^{11,31}

It is worth noting here that the rehabilitation of patients with impairment of other body systems due to tumors besides spinal cord are not routinely excluded from specialist rehabilitation services. As far as we are aware, through contact with general rehabilitation services in our respective countries and discussion with colleagues, people with brain tumors, including glioblastoma multiforme, are not routinely excluded

Table 2 Characteristics of workshop participants, their professional role and type of services available for patients

Variables	Median (interquartile range) or n, %
Age	45, 37.5–53
Years working with survivors of SCD	15, 6–22
Male	24, 60%
Region where work*	
Major city	27, 68%
Regional city	12, 30%
Rural or remote area	2, 5%
Professional role	
Physiatrist or rehabilitation physician	21, 53%
Surgeon	1, 3%
Rehabilitation nurse	1, 3%
Physiotherapist	9, 23%
Occupational therapist	4, 10%
Psychologist	1, 3%
Social worker	1, 3%
Doctor training to be rehabilitation physician	2, 5%
Work in a specialist spinal cord center	
Yes	35, 88%
Role in the decision on whether to admit patients into spinal rehabilitation unit	
Yes	24, 60%
Types of services provided	
Inpatient rehabilitation	40, 100%
Outpatient or community based rehabilitation	34, 85%

SCD = spinal cord damage

* more than one answer possible, total > 100%

Table 3 Reasons given by respondents for people with a tumors as the cause of their spinal cord damage not being admitted to spinal rehabilitation unit and reported admission criteria

	Benign n	Malignant n
Why not admit these patients		
Poor prognosis	0	6
Admission criteria exclude these patients	0	4
Not priority for ward	0	2
Patients unable to participate in therapy	0	1
Transfer these patients to cancer service instead	0	1
No reason given	7	8
Criteria or principles used in admission decision making		
Same as other SCD patients	12	2
Patient able to participate in therapy	7	8
Patient medically stable	6	5
Clear rehabilitation goals	5	5
Cancer treatment not interfering with rehabilitation	3	5
Able to be discharged into community	2	2
Prognosis of greater than 3–6 months	2	11
Carer available, social supports, patient resources	2	2
Pain control good	1	2
Clear and documented SCI involvement	1	0
Patients with multiple problems rejected	1	0
Formal scales (e.g. Tokuyashi, Karnofsky)	0	1
Likely short stay (e.g. discharge < 6 weeks)	0	1
Pressure from referring hospital	0	1
Arbitrary, no specific criteria	0	1
No criteria given	13	3

from neurological rehabilitation programs and those with limb amputation following surgery for osteosarcoma are not excluded from amputee units. Why should people with spinal cord tumors be excluded from specialist SRU?

Based on the above, the opinion of others reported in the literature,^{13,14,16,25} and our expertise, we recommend that the ideal setting for the rehabilitation for people with SCDys due to tumors is in a SRU.

Framework for managing people with spinal cord dysfunction due to tumors in spinal rehabilitation units

Criteria have previously been proposed for guiding decisions regarding the rehabilitation of people with SCDys due to tumors.^{19,20} These form the acronym NOMPS – Neurological, Oncologic, Medical, Pain and Support status of the patient. The key aspects of the NOMPS criteria are summarized as follows:

- N: The neurological status is important because the more complete the grade of spinal cord damage the less likely that the patient will improve.⁵
- O: The oncologic status determines the prognosis, which is a vital consideration in any decision to offer

admission to a SRU compared to palliative care. Prognosis varies considerably for different types of tumors and there is also considerable variation in prognosis for the same type of tumor.

- M: Medical co-morbidities can influence ability to participate in rehabilitation and need to be optimally managed.
- P: Pain is common, multifactorial, and needs a comprehensive evaluation to guide diagnosis of cause(s) and management options.
- S: The patients social supports have a major influence on discharge planning options and the ability to achieve discharge home with adequate supports, either provided by the family or paid for with their financial resources.

We endorse the NOMPS criteria as important for informing the decision to admit people with SCDys due to tumors into SRU. We believe that the NOMPS criteria also provide a very useful basis for conceptualizing a framework and practical considerations to guide the management of people with SCDys due to tumors in rehabilitation. Our framework is presented in Table 4.

Discussion

The literature review highlighted that people with SCDys due to tumors tend to be aged in their 50s or 60s, have a relatively even sex distribution, and that most are discharged home after a shorter SRU length of stay compared with other types of SCDys or traumatic SCI. The survey of rehabilitation health care professionals who attended a workshop on SCDys due to tumors revealed considerable variation in practice regarding whether people with benign or malignant tumors causing SCDys are admitted for rehabilitation, along with variation in the criteria for admission or reasons for exclusion. We have proposed a framework and practical considerations for managing people with spinal cord dysfunction due to tumors in SRUs.

A major strength of this project is the use of mixed methods—literature review, survey and consensus opinion of a panel of experts. This is the most comprehensive literature review regarding SCDys due to tumors of which we are aware. This is the first publication to give a framework and detailed, practical recommendations for the management people with SCDys due to tumors in SRUs.

Limitations of this project include the potential for responder bias among the workshop attendees, which is quite likely given that the majority worked in a SRU. It could be argued, however, that the staff who work in SRU have the clinical expertise which mean that they are most suited to given an informed clinical opinion regarding the management of people with SCDys due to tumors. The sample was self-selected but it is uncertain how this may

Table 4 Framework and practical considerations for managing people with spinal cord dysfunction due to tumors in spinal rehabilitation units

Framework	Practical considerations
Neurological	<ul style="list-style-type: none"> • AIS on admission initial assessment used as the basis for neurological prognosis⁶ and supplemented with the patient/clinicians report of any change since onset along with the tumors prognosis. • In giving neurological (and functional) prognosis need to balance hope vs realism. Honest but empathic. Give some hope, especially if within 4–6 weeks post-onset.
Oncologic prognosis	<ul style="list-style-type: none"> • Essential prior to decision on acceptance of patient for admission to SRU. • Crucial for discharge planning in order to set goals of rehabilitation and guide the setting of target length of stay in rehabilitation • Obtain from oncologist. Occasionally tempered by literature and rehabilitation physician expertise. If difficult to obtain prognosis from oncology team, e.g. if initial contact with junior Drs., it is important to persist and initiate direct discussion between rehabilitation physician and oncologist. One strategy that we have used for obtaining a prognosis where it has been difficult to get is to indicate to acute staff that the patient will not be considered for rehabilitation until a prognosis is given. Suggest asking the oncologist what is the estimated timeframe of the prognosis (for example, less than 3 months, 3–6 months, 6–12 months, 1–2 years, more than 2 years), as well as what management options there are if the tumors recurs/progresses more quickly and the implications of these options. • Suggest that if prognosis more than 3 months then generally appropriate to consider SRU admission. If less than 3 months then generally consider that palliative care unit is more appropriate unless patient function, home environment and resources suggest a very short SRU admission is possible.
Long bone metastases	<ul style="list-style-type: none"> • Obtain orthopedic surgeon or other appropriate specialty advice regarding fracture risk and whether any restrictions on weight-bearing. If high fracture risk and/or restriction on necessary weight-bearing then important to explore prophylactic radiotherapy or surgery prior to transfer into SRU.
Cancer treatments	<ul style="list-style-type: none"> • If patient having radiotherapy or chemotherapy these should not, of themselves, be an absolute barrier to admission into SRU. • Consider nature of treatment and setting where this needs to be given—whether possible within SRU/same site or off-site and the frequency of treatment are the key issues. If weekly/twice weekly treatments off-site then these can easily be factored into the rehabilitation schedule. Suggest schedule patient routine care and rehabilitation in the morning and cancer treatment in the afternoon. If possible schedule cancer treatment on weekends.
Medical	<ul style="list-style-type: none"> • Rehabilitation and other physicians in SRU are the best placed to manage the spinal cord-related issues that occur in these patients and liaise with other specialists as required (e.g. oncology, palliative care, radiation-oncology) • The multidisciplinary team in SRU is best placed to help people with SCDys due to tumors achieve the best possible quality of life by optimizing their functioning and abilities and educating them and their family/carers.
Pain	<ul style="list-style-type: none"> • Pain does not need to be absolutely controlled prior to acceptance for SRU admission. Rehabilitation physicians in SRU, and relevant allied health staff, should have appropriate transferrable expertise in pain management to optimize symptom management that can/should be supplemented when necessary by palliative care, anesthetics, pain program expertise. • It is suggested that if patients can tolerate being transferred by hoist and sit out of bed comfortably for 30–60 minutes then they are appropriate for transfer to SRU if it is believed that further improvement in patients' pain is achievable with the resources available to the SRU.
Support status Pre-admission	<ul style="list-style-type: none"> • Social supports, including immediate and extended family, the physical home environment and financial resources, can be 'game changers' in determining whether timely discharge back into the community is viable. They clearly impact on discharge planning and length of stay in rehabilitation. It is vital to determine the possibility of these been adequate to facilitate discharge into the community in the acute hospital assessment prior to a decision regarding admission to SRU. • It is vital to gauge expectations of the person with SCDys due to tumors and their family, educate them regarding realistic outcomes and discuss objectives of admission to SRU and likely timeframes.
Post-admission	<ul style="list-style-type: none"> • Suggest family meeting occurs within first week after admission to rehabilitation to re-confirm overall rehabilitation goals and discharge plan, estimated length of stay etc. • May need periodic meetings with patient/family involving rehabilitation physician and other team members if the patient/family need to clarify discharge plans and length of stay according to the oncological and functional prognosis.

Continued

Table 4 Continued

Framework	Practical considerations
Rehabilitation	
Reframe mindset of rehabilitation team	<ul style="list-style-type: none"> • Need to educate and support the team to conceptualize the goals and objectives very differently from those used with people who have spinal cord damage due to other causes, especially regarding the need for a very short admission. • Set discharge destination, goals of rehabilitation and estimated length of stay according to prognosis. • Death or transfer to hospice/palliative care is not a failure • Need to consider providing emotional support to staff (burn out/emotional distress). This includes: debriefing of ward staff to experienced colleagues, formal hospital-provided external psychological supports, and repeated education regarding how these patients differ other patients. • The multidisciplinary team is expanded. In addition to the traditional SRU team, radiotherapy, oncology, palliative care, and surgery may be relevant. Need good communication between all involved. • Recommend referral to palliative care while patient still in rehabilitation if prognosis indicates this may be required in the near future, so that they can establish a relationship early.
Length of stay	<ul style="list-style-type: none"> • Length of stay in patients with malignant cancer should be as short as possible to optimize time in community and out of hospital with consideration of oncologic prognosis. A 'short, sharp, shiny' admission is the aim. Ask patient what is important to them to achieve during inpatient rehabilitation what they believe they need to achieve to be discharged. Similarly, ask family what they can do/ provide. • Based on results presented in the epidemiology section of the literature review, a target length of stay of 4–6 weeks is appropriate and recommended for those with a poor prognosis (e.g. less than 6 months)^{10,12,14,16} • If patient/family expresses wish to extend length of stay beyond that recommended by the team to achieve goals the SRU team do not believe are absolutely necessary for discharge with consideration of the oncologic prognosis, one strategy suggested is to explain that the goals the patient wishes to achieve can be addressed by ongoing community/ambulatory or home-based rehabilitation after inpatient discharge. • Patients with a malignant cancer who have had curative treatment (e.g. lymphoma) and those with benign tumor do not need their hospital admission shortened unnecessarily.
Goal setting	<ul style="list-style-type: none"> • Focus on practical aspects of managing at home • Bladder: Indwelling catheter if malignant tumor and poor prognosis and complete spinal cord damage • Fecal continence: Management depends on assistance available and discharge destination. If prognosis is poor then it is appropriate to discharge patient still fecally incontinent if they have resources to manage at home or if going to nursing home, otherwise achieving controlled continence should be a priority. • Equipment: explore options to loan or hire if poor prognosis • Home modifications: focus on the basics that are essential. Consider temporary/portable ramps. It is acceptable to discharge people home who do not have independent access in/out of home or to all areas of home. • Carer training is paramount. • Explore support services to assist the family where these supports exist
Patient support	<ul style="list-style-type: none"> • It is important to provide support from psychology staff and the rest of the SRU team to help optimize the challenging adjustment faced by people with SCDys due to tumor.²¹

have influenced the results. An additional limitation is that we did not include other experts who did not attend the workshop for practical reasons due to limited resources. Furthermore, there are relatively few publications regarding people with SCDys due to tumor—most are from single centers and only one series that involved a small number of participants examined the benefits from a specialist SRU. Some recent publications, however, have been multi-centered⁵ and population-based.²⁶

Future publications should consider reporting the tumor type according whether was it was primary-benign, primary-malignant or secondary-malignant

(metastatic), and it is suggested that a revised version of the International Non-traumatic SCI Dataset³ also consider this approach.

Implications for clinicians and policy makers are that increasing the admission of people with SCDys due to tumors into SRUs may place extra pressure on the limited number of beds in these units. This may necessitate an increase in the number of beds and resources in the SRU, or alternatively, improvement in efficiency of the SRUs to create extra capacity.²⁴ It can be argued, however, that it is quite likely that managing people with SCDys in specialist SRU will improve their outcomes

and use rehabilitation resources more efficiently than their care in non-specialist settings. Admitting people with SCDys due to tumors into SRUs where they have not previously been managed will necessitate changes in practice for the rehabilitation teams and this process will take time and support from senior staff to effectively implement. Future research in this area may include a Delphi process for refining our recommendations.

Conclusions

The successful rehabilitation of patients with tumors causing SCDys should be conceptualized within the context of the patients' circumstances. Patients with tumors causing SCDys should be given greater access to specialist SRU in order to best manage the consequences of the spinal cord damage and optimize their chances of a reasonable quality of life in the community.

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Appendix. Literature search strategy

1. Non-trauma*.ti,ab.
2. Nontrauma*.ti,ab.
3. 1 or 2
4. Spinal cord diseases/
5. Spinal cord injuries/
6. 3 and 4
7. 3 and 5
8. 6 or 7
9. Spinal cord neoplasms/
10. Epidural neoplasms/
11. Spinal cord tumor/
12. 9 or 10 or 11
13. 8 and 12