



Primary Care in the Spinal Cord Injury Population: Things to Consider in the Ongoing Discussion

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Abstract

Purpose of Review Spinal cord injury (SCI) creates unique needs that if not recognized and addressed timely can have detrimental effects on the health and quality of life (QOL) of people living with a SCI. Primary preventive health care is shown to decrease morbidity and mortality, yet the SCI population reportedly faces challenges getting access to this care. This area in SCI health care is still largely understudied with no consensus on the ideal way or which health care provider is best to provide primary care for this population.

Findings Preventive care is generally provided by general primary care providers, but not all primary care providers are trained in recognizing and addressing spinal cord injury-specific needs. SCI providers generally are not trained in addressing all aspects of preventive care. Knowing the recommended preventive care screenings, recognizing and managing specific conditions seen after a SCI, and seamless coordination of care between general practitioners and SCI specialists are some of the interventions to help prevent health complications, decrease morbidity and mortality, improve health outcomes, and promote QOL in this patient population.

Summary Prioritized focus on preventive care is necessary for a positive impact on the overall health and QOL in this population. Addressing the knowledge gap reported by primary care providers and SCI providers may help increase the probability of SCI patients getting their preventive and specialty care needs addressed. We present a “cheat sheet” of recommendations for the preventive care evaluation of a person living with a SCI.

Keywords Spinal cord injury · Health promotion · Preventive care · Primary care provider

Introduction

Spinal cord injury (SCI) is a chronic condition with complexities that have a lasting impact on the health, function, and quality of life (QOL) of people living with a SCI [1, 2]. After sustaining a spinal cord injury, patients' lives are changed, creating some unique secondary conditions that if not recognized and addressed properly in a timely fashion can lead to increased morbidity and mortality [1–4]. As

spinal cord medicine has advanced, SCI specialists have learned much about the physiological, psychological, and societal changes SCI patients experience which have helped improve the health and QOL of these individuals [2, 5]. Recognizing the signs and symptoms of these secondary conditions and knowing how to adequately manage them and how to prevent the frequency of their occurrence are impactful in maintaining the health and well-being of SCI patients [5]. Providers caring for SCI patients should provide health services focused on the specific SCI needs and secondary conditions, as well as general preventive health which is critical in maintaining the health and QOL for all individuals [5]. The average life expectancy for SCI patients is lower than that of persons without SCI [6•]. The literature shows that this population of patients is less likely to receive the same basic health care as compared to persons without SCI and who have unmet health care needs [7].

Depending on the level of the spinal cord injury, the number of secondary conditions the SCI patient has can

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vary. The higher the level of the SCI, the more secondary complications are seen. For example, a person with an injury to the cervical spinal cord (causing tetraplegia) can expect to have more organ systems negatively impacted with more risks for more secondary conditions, as compared to an individual with paraplegia (an injury below the cervical spinal cord) [1, 8]. Helping SCI patients stay healthy requires a knowledge of what spinal cord injury is and its impact on the overall health of those affected. Usually, those knowledgeable about caring for SCI patients are rehabilitation specialists, specifically, those with expertise in spinal cord medicine. They primarily deliver SCI health care in rehabilitation facilities and provide education to both the patients and their identified family caregivers on loving successfully in the community with a SCI [5, 9]. Upon discharge to the community from acute inpatient rehabilitation, the patients usually follow up with their SCI specialists for continued rehabilitation and/or to address secondary complications that can be seen (i.e., spasticity, urinary tract infections, pressure injuries) but not necessarily for primary care issues [5].

What is Primary Health Care?

The World Health Organization speaks to primary health care as “a broader whole-of-society approach” that provides “essential care that can cover the majority of a person’s health needs throughout their lives” and “involves prevention, health promotion, treatment, rehabilitation, and palliation” [10]. It then describes primary care as being a subset of primary health care and “is a model of care that supports first-contact, accessible, continuous, comprehensive and coordinated person-focused care” [11]. The United States Institute of Medicine (IOM) refers to primary care as “the provision of integrated, accessible health care services” provided “by clinicians who are accountable for addressing a large majority of personal health care needs, developing a sustained partnership with patients, and practicing in the context of family and community” [12]. Preventive care focuses on prioritizing health problems, effective interventions, and individualizing screening and prevention interventions, which may differ from patient to patient depending on family history, age, sex, lifestyle, patient preferences, and other risk factors which should be taken into consideration when performing the evaluation [13, 14]. Preventive services are usually provided by primary care providers trained to deliver this care (usually practitioners in internal medicine, family medicine, and pediatrics) [15]. The literature reports a positive association between primary care and the provision of preventive services, and areas with higher ratios of primary care physicians to population had much lower total health care costs than seen in other areas [15–17].

Who Is to Provide Primary Health Care to the SCI Patient?

The International Conference on Primary Health Care in 1978 declared that health, which is a state of complete physical, mental and social well-being, not merely the absence of disease or infirmity, is a fundamental human right [18]. The literature speaks to the challenges individuals living with disabilities (including people with SCI) face to access primary care [19–23]. No consensus exists on who is best to address the primary care needs of SCI patients. When discharged to community living from acute rehabilitation after sustaining a SCI, patients often return for follow-up evaluations with their SCI specialists who provided their acute rehabilitation [2, 9, 24]. These SCI specialists work in rehabilitation facilities which are designed to accommodate people living with disabilities versus a free-standing provider’s office in the community [2, 9, 24]. The facilities are designed to remove physical barriers to care that commonly exist in practitioners’ offices in the community (i.e., transfer systems to get the patients out of their wheelchairs into the examination beds, examination beds rather than small examination tables usually seen in offices) [5, 9, 20]. They also provide accessibility to SCI experts who are trained in preventing, recognizing, and properly addressing co-morbidities associated with secondary conditions seen after a SCI [5, 25]. Although some SCI patients use their SCI specialists as their primary care provider, the SCI specialists may be uncomfortable serving in that capacity and may not feel equipped to provide this care [9, 24, 26, 27]. Primary care physicians are trained to provide preventive care but their training does not address the unique needs of a spinal cord-injured patient [9, 19, 20, 23, 25]. Besides the limitations the lack of training provides, the number of SCI patients they may see in their practice is small, so familiarity is lacking [3, 19, 20, 25, 28]. The infrastructure of primary care physicians’ offices (physical access, exam tables, lack of proper transfer equipment to get the patient out of the wheelchair for examination, etc.) all contribute to the lack of access to primary care in the community for this patient population [20, 21, 28].

There is not a definitive consensus in the literature of which scenario is better to provide primary care to SCI patients. Should it be the SCI Specialists who have expertise in spinal cord medicine and understand the unique needs of the person with a spinal cord injury? Or should it be the family primary care physician who may already have a relationship with the patient prior to the SCI and knows how to manage general preventive health care but not health care specific to a person who has sustained a SCI? Perhaps an integration of primary care and spinal

cord medicine specialists with the use of virtual care technologies may prove beneficial for these patients [3, 9, 22, 25, 29–31, 32••, 33]. Some health care systems have developed processes to increase access to primary, preventive care for SCI patients while also addressing their specialty care needs [2, 3, 6•, 20, 22, 24, 25]. Two of such systems in the USA are the Spinal Cord Injury Model Systems (SCIMS) and the Veterans Health Administration (VHA). The SCIMS began in 1970 to improve care and outcomes for SCI patients and have 14 centers across the nation [34]. Veterans Health Administration (VHA) has a long history of recognizing the importance of prevention in maintaining overall wellness and QOL of Veterans living with a SCI [2, 35]. Its spinal cord injury and disorders (SCI/D) system of care is a national program divided into a Hub and Spokes model with the responsibility to provide lifelong comprehensive primary and specialty care to Veterans living with a SCI/D. There are 25 Veterans Administration Medical Centers (VAMC) across the country including Puerto Rico, designated as the SCI/D Center/Hub with highly trained and experienced interdisciplinary teams of providers who can deal with the unique secondary conditions that develop when someone sustains a spinal cord injury or disorder [2, 35]. Each hub is tasked with working closely with other VAMCs within a defined region (the hubs' spoke sites) to provide comprehensive primary and specialized care to those veterans in their communities. There are no standardized national guidelines of what elements are imperative to be included in the comprehensive evaluation of people with SCI/D nor on the frequency of when these evaluations should be completed. Cognizant of this, the VHA's SCI/D System of care performs a SCI-specific comprehensive preventive health evaluation annually with a focus on the prevention and/ or early identification of complications related to SCI [2].

Recognizing and addressing health issues in SCI patients in a timely fashion are key to preventing morbidity and mortality. Their unique needs often lead to inadequate treatment of their health issues, fewer preventive screenings, less general health promotion, and poorer overall individual health outcomes [6•, 9, 36]. In the final analysis, one could argue that if the SCI patient chooses the general practitioner (internist or family medicine) used prior to getting a spinal cord injury or the SCI specialist as a primary care provider, this provider has the responsibility to take ownership to establish a relationship with the other discipline and facilitate seamless coordinated care for the patient to appropriately address health needs. Both practitioners should have readily available to them, SCI and primary care references to use as a guide when the patient presents to the office (i.e., *Spinal Cord Medicine* textbook by Kirshblum and Lin, UpToDate, articles like this) [37].

For the purpose of this paper, we will focus on adults living with SCI. We will provide an overview of recommended preventive screenings for adults and recommendations for conditions that are unique to the SCI population that can be used by both the SCI specialist and the primary care providers.

Guidelines on Preventive Care

Expert panelists and organizations like the United States Preventive Services Task Force (USPSTF), UpToDate, and Centers for Disease Control (CDC) provide guidance on what comprises preventive care as well as the frequency of when they should be conducted. Recommendations encourage patient-specific preventive services based on the patient's age, sex, sexual activity, pregnancy status, and tobacco use and the Partnership for Prevention which makes recommendations of preventive services based on the clinically preventable burden of disease and cost-effectiveness of interventions [13, 38].

General Screenings

Adults with chronic conditions (spinal cord injury included) should get a wellness evaluation which includes a complete history and physical examination annually [13]. This evaluation should include a review of medications, supplies, and equipment needed.

Cardiovascular Health

Key features of cardiovascular disease (CVD) prevention include risk assessment and treatment of predisposing conditions [13, 38]. Cardiovascular diseases are among the major causes of mortality and morbidity in people living with SCI [39–42]. The increased risk for CVD in this patient population has been reported to be related to multiple cardiovascular risks factors seen after a spinal cord injury such as decreased physical activity, impaired glucose tolerance associated with increased insulin resistance, increased proportion of body fat, obesity, and low high-density lipoprotein [43–45] with some emerging risk factors being hypothesized as contributory (i.e., platelet function, inflammation) [46].

Hyperlipidemia screening should begin earlier for SCI patients than for those without SCI due to the increased risk for dyslipidemia (not age-related but duration of SCI) [13, 38, 46].

After a spinal cord injury, low blood pressure can be seen in cervical and high thoracic SCI (caused by the reduced sympathetic activity below the level of injury resulting in reduced vasomotor tone), but those with lower thoracic and lumbar SCI have normal blood pressures [47]. Currently, it is not established if the target blood pressure levels for

people with SCI should be different from those set for the general population thus, current guidelines used for the general population are applied to the SCI population [46]. Hypertension, unrelated to elevated blood pressures seen in autonomic dysreflexia episodes, is seen in people with SCI so screening for and managing it is important [44, 48, 49]. We recommend that blood pressure should be checked at each provider visit.

Although data about the impact of exercise on cardiovascular risk in SCI are limited, SCI patients should be encouraged to be as physically active doing aerobics and strengthening exercises as their functional level safely allows them [50, 51].

Respiratory Health

Respiratory compromise is one of the leading causes of morbidity and mortality in this patient population, with an increased risk of mortality seen in patients with higher levels and completeness of the spinal cord injury [52, 53]. Respiratory concerns are usually due to muscle weakness from the spinal cord injury limiting secretion mobilization rather than intrinsic lung disease. Consequently, individuals with a high-level spinal cord injury require pulmonary toilet and aggressive secretion management with cough augmentation, especially in the presence of respiratory infections [54, 55]. Pulmonary function should be evaluated prior to discharge from acute rehabilitation and when there is a change in the patient's condition or respiratory symptoms (i.e., COPD, chronic smoking). There is an increased incidence of sleep disorders in the SCI population with studies showing a higher incidence in those with tetraplegia as compared to paraplegia [56, 57]. As there are no standardized recommendations for the frequency of assessment, we suggest that an annual assessment is done. When symptoms suggest clinical decline, assessment and intervention would be warranted. Ventilator-dependent patients need at least annual assessments (and as needed) with routine ventilator care.

Autonomic Function Health

Autonomic dysfunction (including autonomic dysreflexia) is seen after a spinal cord injury as the autonomic nervous system also is affected, leaving an impact on autonomic functions controlled by the parasympathetic and sympathetic spinal circuits (i.e., thermoregulation, orthostatic hypotension, bowel function, urinary bladder function, and immune system) [58].

Patients with a cervical or high thoracic (above T6, although there are reports of it in lower thoracic levels) SCI are at increased risk for autonomic dysreflexia which can be triggered by any noxious stimuli below the level of injury (i.e., tight shoes, rolled up socks, ingrown or

overgrown toenails, distended bowel or distended urinary bladder, intra-abdominal pathology, etc.) [59–61]. For these patients, inquiry about episodes of autonomic dysreflexia should occur during providers' visits. A sudden and severe rise in blood pressure (bp) is potentially life-threatening which requires rapid recognition and intervention to resolve the episode of autonomic dysreflexia (AD). An elevation of systolic blood pressure 20 mmHg above the SCI patient's baseline could be suggestive of autonomic dysreflexia [61]. Some of the symptoms of AD may include profuse sweating or flushing of the skin, rapid onset headache, piloerection, blurred vision, and cardiac arrhythmias but be cognizant of the fact that AD may appear with minimal or no symptoms [61]. When AD is present, the noxious stimulus triggering AD has to be identified and addressed to resolve the episode. If the blood pressure is elevated, immediately put the patient in a seated position with the legs lowered, loosen anything constrictive on the patient's body (shoes, belt, devices, etc.), examine the patient for and address any other triggers (kinked/twisted urinary catheter or tubing, possible distended bladder if no indwelling catheter is in place, fecal impaction, etc.) while monitoring the blood pressure and heart rate every 1–2 min until the episode resolves. If the systolic bp remains elevated at or greater than 150 mmHg, consider pharmacological interventions prior to putting the patient in a supine position [61]. Pharmacological interventions include using an anti-hypertensive agent with rapid onset and short duration (nitroglycerin paste, hydralazine, nifedipine, or sublingual clonidine) [61]. We usually recommend initially using nitroglycerin paste which can be easily wiped off once the noxious stimulus has been addressed and the bp comes down to the patient's baseline. If the noxious stimulus cannot be identified and/or the bp remains elevated, the patient should be transferred to a higher level of care.

Gastrointestinal Health

Changes in both the upper and the lower gastrointestinal (GI) system are seen after a SCI. Depending on the level of spinal cord injury, impaired swallowing, gastric dysmotility, gallbladder dysmotility, delayed colon and rectal transit times, and hemorrhoids have been described [62]. We recommend that at least annually, inquiries about symptoms related to GI disorders including any changes in bowel emptying patterns should be made and the appropriate evaluation should be made as indicated.

Cancer Prevention

Cancer screenings should be performed in people with SCI as per the guidelines for the general population set by the expert panels like the CDC, USPTF, ACS, and European Commission. A thorough personal and family history,

focusing on both biological sides of the family should be taken. A rectal examination is recommended annually for patients over age 40 [62]. Skin monitoring should be at least annually and when suspicious lesions are seen on the skin or in chronic pressure ulcers. Breast cancer screening at 50 y/o (earlier if increased risk). Bladder cancers can be seen in SCI patients especially those who smoke tobacco and use indwelling catheters. Evaluation done by a Neuro-urologist tailored to offer timely surveillance. Women with SCI should receive their cervical screening tests at the same frequency as women in the general population, but they face barriers that impact them getting their cervical cancer screening resulting in screening rates found to be lower than in the general population [63]. Colorectal cancer screening is recommended for people with SCI similarly for the general population. The challenge for SCI patients with neurogenic bowel is achieving a successful pre-colonoscopy preparation [64–66]. Very often they have suboptimal bowel cleansing limiting the diagnostic yield of the colonoscopy when using the colonoscopy preparations regimens used by non-SCI patients. Modification of the bowel preparation used for the general population has been reported to be tolerated and provides better opportunities for a successful colonoscopy [64]. Although the literature does not provide one definitive pre-colonoscopy preparation regimen, the consensus seems to include an extended preparation period requiring more than a few hours prior to the colonoscopy (often multiple days), split dosing of oral regimens may be more tolerable, assistance may be needed with managing the voluminous amount of bowel results during the preparation [64, 65, 67]. See Table 1.

Genitourinary Health

Voiding dysfunction is a common occurrence after a SCI and is a major contributor to medical complications (urinary tract infections, urosepsis, renal and bladder calculi, renal insufficiency, cancers, etc.) with increased health burden and altered QOL [68–71]. There are no standardized recommendations on the optimum frequency of surveillance and tests of the urinary tract system, but there is consensus for regular genitourinary system evaluation in these patients. Depending on the type of bladder management implemented, yearly cystoscopy and urodynamic studies may be warranted looking for bladder calculi or bladder cancers [72, 73]. With an increased risk of renal and bladder calculi, it may prove beneficial to image the renal and urinary bladder systems at least once after the SCI and as clinically indicated (history of stones formation, pyelonephritis, prior changes in GU anatomy, i.e., pyelonephritis). With the increased risk to the upper urinary tracts in patients with neurogenic bladder, and the other metabolic complications that can be seen after a SCI (glucose intolerance), monitoring the renal function

annually is warranted the longer the person has had an SCI [74, 75]. Proper surveillance allows the clinician to avoid or address common urological complications.

Sexual Health

Sexual health can be negatively impacted by a spinal cord injury and research has shown that improving sexual functioning can improve the quality of life of people living with SCI [76–79]. There are many ways sexual dysfunction and fertility issues can be successfully managed so we recommend that at a minimum, annual assessments should occur. The literature indicate that sexual and fertility rehabilitation is best addressed in a biopsychosocial manner and include various disciplines [80]. Men with SCI may have erectile and ejaculatory dysfunction as well as abnormal sperm quality [81, 82]. In females with SCI, sexual function and reproduction are also affected with increased risk for complications during pregnancy requiring close monitoring [83]. There are few recommendations in the literature about contraceptives in females with SCI. Caution is needed with contraceptives in females with a SCI as high-dose estrogens are associated with increased risks of thrombophlebitis, intrauterine devices are potentially associated with increased autonomic dysreflexia risks, proper placement of intravaginal devices (diaphragms, rings, cervical caps, etc.) can pose a challenge due to decreased or absent sensation in the perineum after SCI [83, 84].

Women with spinal cord injury at risk of autonomic dysreflexia who are pregnant should be counseled to consider spinal or epidural anesthesia during labor. If these individuals develop elevated systolic blood pressure, an etiology of autonomic dysreflexia needs to be differentiated from preeclampsia [61].

While addressing sexual health, inquiry about sexual orientation and activities is important for appropriate health screenings, addressing any negative impact of sexual dysfunction on the patient and being able to provide resources to address any concerns [77, 85]. There is limited information in the literature about SCI patients who identify as lesbian, gay, bisexual, transgender, queer and/or questioning, intersex, asexual (LGBTQIA+). Health care providers caring for LGBTQIA+ people who have neuro-disabilities including a SCI should know the importance of understanding the needs and expectations of this community to minimize complications or deterioration in their health. Preventive care in this patient population is paramount because there are reports of depression, substance use, health care disparities including lower rates of cancer screening, higher incidence of certain cancers, and higher cancer mortality rates [86–88]. Providers should also manage their personal biases when caring for the LGBTQIA+ as the literature reports that the patients may conceal their sexual orientation and gender identity for

Table 1 Quick summary

Selected cancers screenings					
Screening item	Ages	Frequency	Female	Male	Notes
Tobacco screen	> 19 years old	Annually	X	X	Each visit if indicated
Breast cancer	50 years old	Annually	X		Individualize; can start at age 40
Ovarian cancer	*Refer to notes	*Refer to notes	X		*High-risk family history that suggests a possible hereditary syndrome for ovarian cancer should be referred to a genetic counselor
Cervical cancer	+21 years old	*Refer to notes	Cervix present		<ul style="list-style-type: none"> • 21 to 29 years old: we suggest Pap test screening every three years • 30 to 65 years old: Co-testing (Pap and HPV testing together) every five years OR Pap test alone every 3 years • Age ≥ 65 years old: if negative prior screening, no further screening is needed
Colorectal cancer	+45 years old	As clinically indicated after the 1st one	X	X	No risk factors—aged 45 and older. (family history increases the risk so early testing)
Prostate cancer	+50 years old	Annually		X	If high risk, annual testing begins at 40 years old
Skin cancers	*Refer to notes	Annually	X	X	*Melanoma ≥ 50 years old
CDC vaccine recommendations					
	Ages	Frequency	Notes		
Influenza	≥ 18 years old	Annually			
Pneumococcal	≥ 19 years old				
HPV	*Refer to notes	*Refer to notes	<ul style="list-style-type: none"> • Full series • ≥ 19–26 years old • Now can give to adults 27–45; sexually active history 		
Hepatitis A vaccine	≥ 19 years old	One time series	High exposure to health care workers and medical facilities		
Hepatitis B vaccine	≥ 19 years old	One time series	High exposure to health care workers and medical facilities		
COVID-19	Age > 5 years old	One time			
Varicella vaccine	*Refer to notes	One time series	<ul style="list-style-type: none"> • > 19 years old if lack of previous infection or vaccination (if born in 1980 or after) • Routine varicella vaccination for healthy persons > 13 years of age without evidence of immunity 		
Zoster vaccine	> 50 years old	One time series	Individuals who are 50 years of age or older. If severely immunocompromised, can give earlier		
Measles, mumps, and rubella vaccination	> 19 years old if no evidence of prior immunization	One time series			
Tetanus, diphtheria, and acellular pertussis vaccination (Td/Tdap)	≥ 19 years old and thereafter a booster every 10 years	Booster every 10 years			
Meningococcal	> 19 years old				

Table 1 (continued)

Other screenings	Frequency	Notes
Screening item		
Diabetes	Annually	HgbA1c: screen annually; if diagnosed with Diabetes, q 3–4 months
Obesity	Annually	A BMI ≥ 22 kg/m ² label as obese
Thyroid screen	Annually after injury and if not treated	If low, supplement to keep levels > 30 ng/ml
Vit. D level	Annually	<ul style="list-style-type: none"> • Glaucoma > 40 years old: annually • Diabetes: annually
Eye exam	Annually	Each visit/annually: assess for contributory factors, review medications, and ask about home safety
Falls or fall risk and mobility	*Refer to notes	<ul style="list-style-type: none"> • One-time screening; ages 65–75 years old, current or former smokers • One-time ultrasound screening for AAA in men ages 65 to 75 who have never smoked but who have a first-degree relative who required repair of an AAA or died from a ruptured AAA
Abdominal aorta aneurysm screen	*Refer to notes	

fear of suboptimal quality of care [85, 89–91]. For patients using gender-affirming hormone therapy (GAHT) such as exogenous feminizing hormones or masculinizing hormones, their unique needs cannot be ignored, highlighting the importance of health care providers being aware so that proper care is delivered and timely referrals to specialists made [13, 89]. They are to get the same screenings as the general population while taking into consideration certain unique scenarios [13].

Personal Equipment Needs Assessment

Annually assess their equipment needs and safe use of equipment they have (power wheelchairs, transfer systems, etc.).

Neurological Health

SCI-specific neurological exam based on the International Standards for Neurological Classification of SCI (ISNCSCI) should be completed annually (and as needed based on presenting symptoms) assessing for any changes in the neurological level and American Spinal Injury Association (ASIA) Impairment Scale [8, 92]. Changes in the findings of this exam can identify subtle changes which usually warrants further investigation (e.g., assessing for a syringomyelia, degenerative joint disease, etc.) for interventions avoiding further deterioration in the individual's function and overall condition.

Pain and Spasticity

SCI patients frequently experience pain and spasticity with varying impacts on their health and QOL [93–96]. Besides the neuropathic and nociceptive (i.e., musculoskeletal) pain seen after a SCI, many also may experience other pain syndromes (i.e., complex regional pain syndrome) [96]. It is important to evaluate the patient for pain and spasticity, assessing for any possible effects it may have on their health (depression, substance use, emotional and physical health, etc.) [95–97]. We propose that this is done at least annually with follow-up on subsequent visits to ensure it is properly addressed.

Oral Health

A visual oral exam should be performed annually and a thorough evaluation by a dentist annually or twice a year [98] as poor oral health and periodontal diseases have been associated with cardiovascular risk factors.

Nutritional Health

We recommend that annually and as indicated, the patient's dietary and fluid intake, and weight should be assessed, with a referral to a registered dietitian made as indicated. Some patients may opt to see a nutritional therapy practitioner [99].

Endocrine Health

Physiological changes that occur after a SCI increase the risk for impaired glucose metabolism [100]. Due to disorders of oral tolerance often being occult unless provocative testing is performed and the increased prevalence of glucose intolerance in SCI patients, it is recommended that an oral glucose tolerance test is performed at least once every 5 to 10 years, or if clinically suspected [101]. However, since there are reports of the lack of correlation reported between fasting blood glucose, hemoglobin A1c and oral glucose tolerance testing seen in SCI patients, it may prove beneficial to measure serum HgBA1c as a screening test in this patient population because it documents average carbohydrate handling and glycemic control [100–102]. There is a lack of specific recommendations for the frequency of screening for diabetes and dyslipidemia in place for SCI patients so we rely on the guidelines used for the general population, but this may not be the best for this patient population [103].

SCI patients experience a rapid resorption of bone during the acute injury phase and the development of osteoporosis after SCI predisposes patients to fractures of the extremities below the level of injury [104, 105]. Literature review did not identify established recommendations and guidelines highlighting the benefits of using bisphosphonates in chronic SCI. There may be some benefits in those with low levels of SCI due to the mechanical impact of ambulation on bone health.

Low vitamin D levels can be seen in SCI patients; therefore, measuring the levels of 25-hydroxyvitamin D (25-OH D) and supplementation to maintain a level > 30 ng/ml is recommended [100, 104, 105]. This should be checked at least annually.

Changes in thyroid hormone levels during the acute and chronic phases of SCI have been described in the literature but the observed changes do not necessarily require medication, thus correlation to clinical presentation is warranted [105–107]. With no firm evidence published for the frequency of assessment in SCI patients, we recommend that at least annually thyroid-stimulating hormone should be checked.

Musculoskeletal Health

As no standardized guidelines are available, we recommend an annual assessment for spasticity. When there is a change in spasticity, evaluation is warranted as changes in spasticity can indicate serious complications that need immediate attention, i.e., infections, pressure injuries, or development of a syringomyelia. Complications of spasticity range from pain, falls, fractures of extremities, and improper positioning in the wheelchairs to contractures.

Falls risk and mobility should be assessed at each visit. Assess for contributory factors, review medications, and ask about home safety.

There is an increased risk of developing heterotopic ossification (the formation of extrasosseous lamellar bone in the soft tissue surrounding joints below the level of the spinal cord injury) [100, 108, 109]. Complications seen include a decrease in or loss of range of motion, interference in function and seating positioning in wheelchair, pressure injury, pain, and spasticity. Clinicians should inquire about any changes in the range of motion and keep a high index of suspicion if a patient presents with isolated elevated alkaline phosphatase on routine labs, or warmth on examination of joints, etc.

Vascular Health

A one-time ultrasound screening for abdominal aorta aneurysm (AAA) in men ages 65 to 75 years who are current or former smokers and men ages 65 to 75 years old who have never smoked but who have a first-degree relative who required repair of an AAA or died from a ruptured AAA is recommended [13, 38, 110].

Psychosocial Health

Annual and as indicated screenings for psychological conditions such as depression, anxiety, and substance use are recommended with referrals for treatment as indicated [13, 111, 112]. Dependence on others for assistance with their activities of daily living warrants screening for abuse (caregivers, intimate partner abuse, and elderly abuse) frequently.¹¹³

Immunizations

The CDC provides guidelines on immunization. SCI patients should get their immunizations unless allergies or a history of adverse effects to the vaccines. SCI patients are at high risk for respiratory illnesses and thus should get their immunizations for protection against respiratory diseases including immunization against the current SARS-COV2 [110].

The CDC recommends that people in frequent contact with health care workers should receive immunization against hepatitis A and B [110]. SCI patients fall in this category so they should be offered these vaccines if their screening shows that they have no prior exposure to or immunization against these viruses. With the risk of hepatocellular cancers in chronic hepatitis C infection, hepatitis C virus screening should be done as part of their annual health check if the initial results are negative so that if the patient converts, hepatitis C surveillance can begin and referral to a hepatologist for further evaluation for eligibility for hepatitis C treatment is made.

Patients with SCI have a lot of metal equipment so they should be immunized against tetanus as recommended by the CDC [110].

SCI patients can be sexually active so offering immunization against sexually transmitted diseases is indicated (i.e., hepatitis B and HPV) [13, 110]. Similarly to the general population, screenings for HIV infection (until age 75 years old) [13, 110], chlamydia, gonorrhea, and syphilis, if high risk (multiple sexual partners, men having sex with men, prison history, a history of prior chlamydial or other sexually transmitted infection, new or multiple sex partners, sex partner with concurrent partners, etc.) are recommended [13, 110].

Conclusion

SCI has secondary conditions that can increase morbidity and mortality, negatively impacting the QoL of people with SCI. Preventive care would best serve them similarly to how it positively impacts the health of the general population. At a minimum, patients should undergo an annual history and physical examination and include specific surveillance tests individualized to the patient. The question of who the provider coordinating the care of these patients should be, is not clearly defined in the literature. Efforts should be made to define a model of care that would meet both the primary preventive and specialty care SCI patients need and deserve. There is a need for policymakers, spinal cord injury specialists, graduate medical education programs, etc. to focus attention on bridging the gap in addressing the needs of people living with disabilities including SCI patients. This manuscript attempts to provide an overview of preventive care in this patient population.

Declarations

Conflict of Interest The authors declare no competing interests. The authors are employed at a Veterans Administration Hospital.

Human and Animal Rights and Informed Consent This article does not contain any studies with animal subjects performed by any of the authors. The studies using human participants have been approved by the appropriate institutional and/or national research ethics committee and have been performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

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●● Of major importance

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