Feeding disorders and nutritional needs in patients with spinal cord injuries

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ABSTRACT

Poor nutrition in spinal cord injury (SCI) patients can lead to medical complications such as skin ulcers, osteoporosis, obesity, diabetes, dyslipidemia, neurogenic problems of the intestine and bladder and fitness issues that can affect mobility and functional independence. The aim of this study was to review feeding disorders and nutritional needs in patients with SCI. For this reason, a review of the current literature was performed by using the online PUBMED database and the following keywords: "spinal cord injuries" AND ("diet" OR "nutrition" OR "malnutrition" OR "feeding" OR "eating disorders" OR "nutritional needs"). The search retrieved a total of 509 papers. After screening of titles and abstracts, 426 articles were rejected as irrelevant with the topic. Of the 83 remaining publications evaluated, 43 were rejected for various reasons. After reviewing the reference lists of the remaining studies, 6 more studies were identified. Finally, 46 studies were included in the present review. Patients with SCI are disabled for life and must change their lifestyle greatly. Injuries in cervical spine may compromise the process of swallowing, causing dysphagia and respiratory complications. The risk of under-nutrition and malnutrition in SCI patients is high. Poor diet negatively affects overall health leading to obesity, cardiovascular disease, diabetes mellitus and metabolic syndromes. Patients with SCI must follow a proper diet to ensure that the right amount of nutrients is delivered for sustaining the appropriate physiological mechanisms.

Key Words: Nutritional needs, Spinal Cord Injuries

Introduction

Spinal cord injury (SCI) affects the ability of the spinal cord to control motor, sensory and autonomic functions below the level of injury. A complete SCI results in loss of sensation and motion below the level of the injury, however, in cases of incomplete lesions, part of the mobility or sensation continues to exist [1]. SCI is less common than brain injuries, having an annual incidence of up to 40 cases/100,000 people, and most frequently affects young people. The main cause of SCI is traffic accidents, followed by sports injuries and occupational accidents. In case of injury, the spinal cord responds similarly to the brain. Bleeding, hematoma formation and neuronal damage is followed by a long phase of recovery [2]. Although SCI is usually located at a certain site, it affects the entire body area innervated by nerves deriving from the site of injury. Morbidity and mortality of patients

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with SCI has improved significantly in recent years due to the great progress that has been made in the provision of first aid [3].

Following serious SCI, there is high probability that patients will suffer from nutritional insufficiency, despite recent advances in medicine and nutrition science. In the immediate post-traumatic period, the metabolic needs of SCI patients are considered similar to those of patients with traumatic brain injuries. Research has shown that 40% to 50% of hospitalized SCI patients are at high risk of malnutrition, while up to 12% of patients are severely malnourished [4]. Poor nutrition can lead to medical complications such as skin ulcers, osteoporosis, obesity, diabetes, dyslipidemia, neurogenic problems of the intestine and bladder and fitness issues that can affect mobility and functional independence [5]. In contrast, a healthy diet rich in nutrients can help provide energy and boost the immune system, helping patients rehabilitate and live a more productive life [6].

Focusing on diet and fluid intake is crucial for SCI patients, as many of the observed complications such as infections of the urinary and respiratory tract are exacerbated by weight loss and dehydration [7]. On the other hand, it is possible for patients with SCI to have a lower metabolic rate due to denervated muscles. This means that some patients may need to decrease food consumption, as the body needs fewer calories to burn [8]. Maintaining an ideal weight and a proper metabolic rate is vital in reducing the risk of diabetes, heart disease and other obesity-related problems. Regular exercise is also vital for maintaining activity and increasing metabolic rate [9].

The aim of this study was to review feeding disorders and nutritional needs in patients with SCI. A review of the current literature was performed by using the online PUBMED database and the following keywords: "spinal cord injuries" AND ("diet" OR "nutrition" OR "malnutrition" OR "feeding" OR "eating disorders" OR "nutritional needs"). The search included studies that were written in English language and were published after 2000. Studies in other than English language, non-adult studies, experimental studies, review papers, commentary papers, and study protocols were excluded from this review

Discussion

The primary search retrieved a total of 509 papers. After screening of titles and abstracts, 426 articles were rejected as irrelevant with the topic. Of the remaining 83 publications evaluated, 43 were rejected for various reasons. After reviewing the reference lists of the remaining studies, 7 more studies were identified. Finally, 47 studies were included in the present review (Table 1).

Feeding disorders

Diet plays an important role in the rehabilitation of SCI patients. Patients with SCI often suffer from anorexia. Between the 2nd and 4th week after injury, weight loss becomes apparent [10]. In the acute phase, patients with cervical SCI may suffer from respiratory insufficiency due to neurologic impairment of respiratory muscles and autonomic changes that, occasionally leading to temporary or permanent artificial ventilation and disturbance of normal feeding. Dysphagia, following cervical SCI is an under-recognized complication leading to an increase of complications and morbidity. The term dysphagia is used to describe swallowing disorders, which affect the smooth transport of food from the oral cavity to the stomach. The incidence of dysphagia has been reported to be as high as 40% [11-12]. Dysphagia requires early diagnosis and special management to prevent possible complications. Risk factors include age, tracheostomy, ventilator use, nasogastric tube and anterior spinal surgery [7,11,13]. The latest has been associated with more than 50% risk of developing swallowing impairment and post-operative dysphagia [14-17]. Surgical implants in the anterior cervical spine may compress the pharynx or esophagus and change the pressures during swallowing. Moreover, anterior neck muscles supporting swallowing can be stretched or damaged intraoperatively. The recurrent laryngeal nerve, innervating most of the intrinsic neck muscles, may be damaged during anterior of cervical approach, causing dysphagia and hoarseness. The impairment of sensation disables patients from feeling the food or liquid residuals in the valleculae and pyriform sinuses [18]. Patients with dysphagia are at higher risk for pneumonia due to aspiration, atelectasis and prolonged hospitalization [12]. Aspiration is defined

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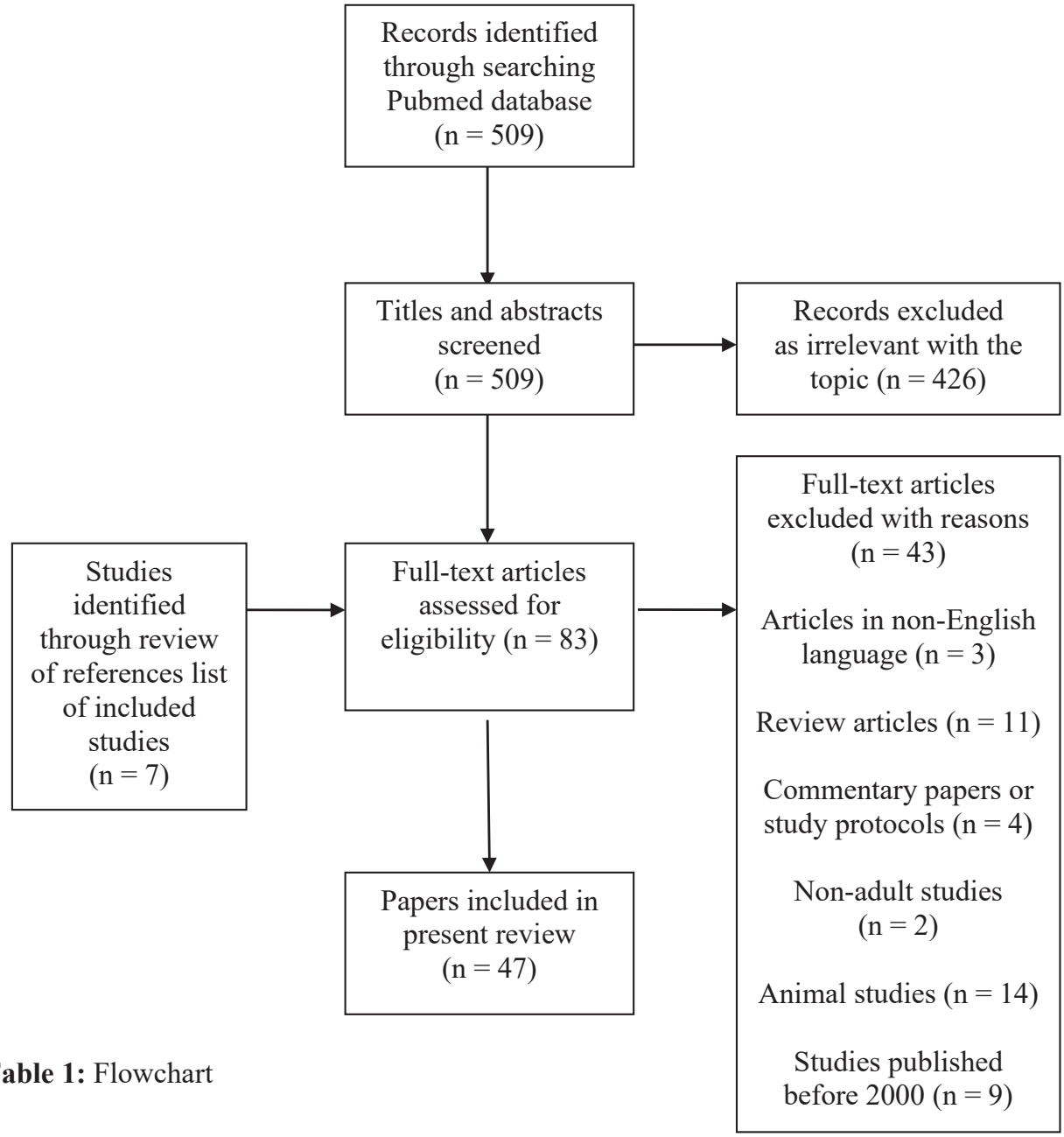

Table 1: Flowchart

as the passage of material (such as oral secretions, food or drink, or stomach contents) from the oropharynx or gastrointestinal tract into the larynx, below the vocal cords. Under normal conditions, in case of aspiration, coughing will clear the respiratory tract. However, in patients with high level SCI, this protective cough reflex is often disrupted [12,19]. The symptoms of dysphagia include coughing or choking, clearing of throat, watery eyes, runny nose, wet vocal quality during or after meals, decreased excursion of larynx or uncoordinated laryngeal movement, audible swallow, weight loss and unexplained, recurrent pulmonary infections.

Another complication of cervical and thoracic SCI, usually seen in the acute post-traumatic period, is ileus. The stomach becomes atonic and significantly stretched. For this reason, a nasogastric tube is placed to empty the stomach and to reduce the risk of aspiration.

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Aerophagia is also common in these patients. When ileus is restored, the nasogastric tube is replaced with a nasoduodenum tube to feed the patient while he is under mechanical ventilation or cervical traction. Stress gastric ulcer, with gastrointestinal bleeding, is another major complication, usually occurring on the 10th-14th post-traumatic day, mainly in quadriplegic patients taking steroids, with an incidence of more than 20%. Early administration of sucralfate and early intestinal feeding are required as a precaution.

Nutritional needs

The risk of under-nutrition and malnutrition in SCI patients is high [20-24]. Nutritional needs in SCI patients include: the need for energy production, the need for protein intake and the need for hydration. Particular attention should be paid to metabolic variations and the nutritional status of SCI patients, with a focus on improving their main medical problems [25].

Acute phase

In the immediate aftermath of injury, various hyper-metabolic and hyper-catabolic processes and responses have been documented, that may lead to malnutrition, loss of muscle mass, increased susceptibility to infection and reduced healing ability to pressure ulcers [26-28]. The paralysis and functional losses that usually occur after SCI produce additional metabolic and eating disorders. These eating disorders are more important in the acute phase, where they play a decisive role in patient's future course. During the first month after injury, decreased serum protein levels associated with malnutrition increase mortality in patients with cervical SCI [29]. Optimal nutritional evaluation and patient management can potentially minimize complications associated with acute injury and long-term rehabilitation [30]. The loss of muscle tone due to muscle paralysis below the site of injury results in decreased metabolic rate, initial weight loss and increased risk of osteoporosis [31]. In the acute post-traumatic period, the patient is likely to lose part of his body weight. To prevent excessive weight loss, acceptable body weight limits have been set. For patients with paraplegia and quadriplegia, these limits are 5% to 10% less than the ideal body weight and 10% to 15% less than the ideal body weight, respectively [32]. At the initial post-traumatic period, when patients cannot consume enough food orally, a more aggressive support should be chosen to ensure that they receive necessary amount of basic nutrients. Intestinal feeding initiated within 72 hours is an alternative method of intervention. A patient with a functioning gastrointestinal tract may be given intestinal support when he should not or cannot receive oral nutrition [33-34]. Patients with acute SCI tend to be malnourished at first due to traumatic stress, anorexia, and possible sepsis. As it is well known, effective resuscitation and release from mechanical ventilation also depends on good nutrition. Total parenteral feeding is early initiated after the injury and as soon as the digestive function is restored, it may be replaced by intestinal feeding. This type of nutritional support is indicated in patients who have gastrointestinal tract dysfunction and inability to swallow food (increased risk of aspiration) or greater tolerance to intestinal nutrition. As with intestinal nutrition, the duration of support influences the decision to prevail over one of the 2 available lines: peripheral parenteral nutrition and central or total parenteral nutrition. The peripheral parenteral nutrition is considered a short-term complementary intervention. It is recommended to use it for a period of less than 14 days, where it is used for transitional treatment [7].

Rehabilitation phase

In the rehabilitation phase, the nutritional needs of SCI patients are observed to decrease by 25% to 50%, due to the reduced mobility and the severe limitation of the muscle tone. This results in a significant increase in the likelihood of developing obesity and metabolic syndrome, which complicates the recovery process and compromises functional independence [31,35-39]. Patients with chronic SCI have a higher total body fat content in comparison with acute SCI patients [40]. On the other hand, physical disability may incommode feeding causing under-nourishment [41]. Finally, prolonged immobilization results in a reduction of patient's bone mass due to bone demineralization, thereby increasing the risk of osteopenia, osteoporosis, and fractures. It is worth noting that patients with quadriplegia should receive almost the same amounts of micronutrients and macronutrients as they would if they were not quadriplegic. Therefore, their food

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quantity does not change significantly, the only thing that changes is the way they eat their meals, since they are fed through intestinal catheters [42-43].

Western food pattern is mostly associated with increased serum triglycerides and cholesterol levels for SCI patients [44]. In contrast, fruits and vegetables are essential for adequate dietary intake of nutrients and a high-protein diet improves insulin sensitivity and bone mass [45-46]. SCI has been associated with a state of chronic low-grade inflammation. Anti-inflammatory diet has been found to reduce pain and edema and improve cognition and mobility [47]. In a randomized, controlled clinical trial, a 3-month anti-inflammatory diet was effective at reducing chronic inflammation in patients with SCI [48].

Neurogenic bowel and constipation are common in SCI patients, affecting their appetite. A healthy diet can help manage these symptoms. Fiber is a key aspect for bowel regulation. It is recommended to receive 30 gr of fiber per day to help the intestine component move through the bowel [49]. However, for some patients, having more than 20 gr of fiber per day can increase the chance of constipation. So, patients should gradually increase their fiber intake and evaluate the response. Good sources of fiber are whole grain breads, fruits and vegetables as well as whole grains such as popcorn. Consuming large amounts of water is also recommended to make the bowel component softer. It is recommended that SCI patients drink 1.5 liters of water a day [50]. Sometimes, increasing the fiber content of the diet and increasing fluid intake are usually not enough to treat the problem and laxatives are often required.

Another major problem for these patients is the increased likelihood of developing ulcers, which contribute to increased morbidity. Maintaining a good level of nutrition through a balanced diet and adhering to personal hygiene rules can help the prevention of bed sores [51]. To help the healing of ulcers, it is essential for SCI patients to receive enough proteins (more than 1.5 gr / kg / day) in their diet. The recommended caloric intake is 30 kcal / kg / day. Regular food intake is important to prevent skin breakdown while making sure that every meal contains a variety of nutrients, vitamins and minerals. Another crucial aspect of preventing skin ulcers is to drink plenty of water to ensure that skin is sufficiently hydrated [52].

People with SCI are also at increased risk for urinary tract infections (UTIs). It is important to drink plenty of water so that the urine is light in color. However, too much water can lower blood sodium causing confusion, cramps, and chills, so it is vital to ensure that there are sufficient minerals in the personalized diet of these patients. In general, SCI patients should drink water about half a liter more per day than the general population to prevent UTIs and to maintain proper bowel function [53]. Cranberry juice is also known to help prevent UTIs by reducing the levels of bacteria in the urinary tract. A glass of pure blueberry juice up to three times a day can help [54].

Dietary recommendations

Literature data are scarce concerning the best suitable diet for chronic SCI patients to lower cardiovascular risks. Given their lower metabolic demands, the evaluation of energy equilibrium is vital to define the appropriate caloric deficit for the prevention of cardiovascular disease. For this purpose, diets should decrease or exclude high-caloric foods, such as saturated fats, simple sugars, refined grains, and alcohol. In a prospective comparative study by Szlachcic et al, dietary intervention with reduced consumption of fat, sodium and alcohol was proven to be an effective initial treatment for 222 SCI patients, reporting positive alterations in lipid and metabolic profiles [55]. Recommended daily caloric intake is 1200 kcal; otherwise 23 kcal / kg / day for tetraplegic patients and 28 kcal / kg / day for paraplegic patients. Recommended protein intake is 0.8 mg / kg / day. A 6-month Mediterranean-style diet with a daily intake of 1200–2000 kcal along with resistance exercise led in reduction of body mass and sugar levels in obese SCI patients [4].

The use of nutritional supplements is common in SCI patients, especially in older adults and under-nourished patients [41, 56-57]. However, in a prospective cohort study, by Javierre et al, including 19 SCI patients, a daily supplementation of 1.5 gr of docosahexaenoic acid and 0.75 gr of eicosatetraenoic acid, was found to cause no significant changes in serum lipid levels [57]. Vitamin D supplementation is useful for maintaining normal plasma 25(OH)D levels

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[58-59]. In a prospective comparative study, 34 elite athletes with SCI received 35000 to 50000 IU of vitamin D per week, for 4 to 8 weeks. The authors observed that after supplementation, 91% of the participants had normal serum levels of vitamin D, when only 26% of the participants had normal serum levels of vitamin D before supplementation [59]. Similar were the results of a prospective, placebo-controlled trial by Flueck et al, assessing the supplementation of 6000 IU of vitamin D per day, in 20 elite wheelchair athletes with SCI. All athletes that received vitamin D increased serum levels to optimum [60]. In addition, it has been found that relatives should be involved in SCI patients' nutrition, as they appear to affect dietary behavior [61]. British NHS Guidelines recommend that SCI patients should receive 700 mg of calcium per day, vitamin D supplementation in ages over 65, five portions of fruit and vegetables per day, less than 70 gr of processed meat per day and less than 6 gr of salt per day [62]. Australian Dietary Guidelines recommend that chronic SCI patients should receive daily 2 portions of fruits, 5 to 7 portions of vegetables, 3 to 6 portions of grains foods, 2 to 3 portions of lean meat, 3 to 4 portions of milky products and 15 to 20 gr of fiber. Less than 30% of calories should be received by fat [63].

Conclusions

Patients with SCI are disabled for life and must change their lifestyle greatly. Injuries in cervical spine may compromise the process of swallowing, causing dysphagia and respiratory complications. In addition, the risk of under-nutrition and malnutrition in is high. Poor diet negatively affects overall health leading to obesity and causing cardiovascular disease, diabetes mellitus and metabolic syndrome. Patients with SCI must follow a proper diet to ensure that the right amount of nutrients is delivered for sustaining the appropriate physiological mechanisms.

Conflict of interest

The authors declare no conflicts of interest.

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