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Mini Review

Need for Appropriate Type and Level of Care in Quadriplegia

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ABSTRACT

Spinal cord injury often leads to quadriplegia, where patients lose functioning in all four extremities. Those with quadriplegia are at increased risk for several complications that enhance health-related costs, shorten life expectancy and diminish quality of life. Here, we review issues in quadriplegia and how to improve outcomes in individual patients.

Keywords: Spinal cord injury; Quadriplegia; Physical; Trauma; Prognosis; Bone

INTRODUCTION

Spinal Cord Injury (SCI) has been documented as far back as 2,500 years B.C. and today occurs in up to half a million people each year [1,2]. It occurs when pathophysiological processes in the spine lead to destruction through processes such as inflammation, apoptosis, ischemia and oxidative stress, causing major dysfunction in motor, sensory and autonomic systems [3]. When discontinuity within the spinal cord occurs, conduction of impulses are disrupted, leading to functional alterations [4].

The condition now affects more than 2.5 million people across the world [4,5]. According to the National Spinal Cord Injury Statistical Center, approximately 18,000 cases occur in the U.S. alone each year [6,7]. Roughly 14% of all SCIs result in complete quadriplegia, also known as tetraplegia, meaning there is a full loss of neurologic function below the site of injury [8]. In many cases, incomplete quadriplegia occurs, where some sensation and motor functioning is retained below that site [9].

Injuries from SCI may be transient or permanent, and in the latter cases, are extremely costly. In quadriplegia, where all four extremities are affected, the lifetime estimated cost exceeds 1 million dollars per patient [10]. Because those with quadriplegia face lifelong dysfunction and increased risk for complications, providing the appropriate type and level of care is critical for minimizing pain and suffering, optimizing quality of life, and maximizing longevity. Here, we review causes and outcomes related to quadriplegia, including relevant complications and the care required to adequately prevent or overcome those complications.

QUADRIPLEGIA OFTEN OCCURS DUE TO PREVENTABLE CAUSES AND RISK DEPENDS ON RACE, SEX AND AGE

Trauma to the cervical spinal cord anywhere between the cervical vertebrae (C1 to C7) is the most common direct cause of quadriplegia [9]. However, the condition can also occur as a result of non-traumatic causes, such as infectious, autoimmune, vascular, or cancerous conditions [11,12]. In some cases, SCI may result from inflammation, metabolic disturbances, toxic exposures, or lack of blood flow [2]. Nonetheless, 90% of SCIs are traumatic, and they tend to result from preventable causes such as motor vehicle accidents, violence, falls, and sports [2,13,14].

The data on show that about a quarter of SCIs in the U.S. occur in the black population and that males are more likely than females to endure SCI [6,7]. Since 2015, about 79% of SCI cases in the U.S. have occurred in males.

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There is some inconsistency in the data on the age at which people are at highest risk for SCI, but late adolescence and early adulthood appear to be the most likely times for SCI to occur [2,11]. Some of the inconsistency in age data may be due to the fact that men tend to endure SCI at younger ages, whereas women's risk is bimodal, with peaks both early and late in life [14].

QUADRIPLEGIA PATIENTS SUFFER SIGNIFICANT COMPLICATINS

Those who experience quadriplegia lose motor and sensory functioning in their arms, legs, trunk, and pelvic organs and are likely to suffer one or more of several potential complications.

Respiratory complications

In those with quadriplegia, the leading cause of both morbidity and mortality is respiratory complications [15,16]. In these cases, SCI causes weakness in respiratory muscles that impairs lung function and the ability to cough. Pneumonia is particularly likely to develop in those with poor inspiratory muscle strength. People with lesions above C3 cannot maintain spontaneous respiration, and those with high cervical cord lesions are often dependent on ventilators [9].

Urinary and bowel complications

Gastrointestinal Tract (GI) dysfunction often presents lifelong challenges for SCI patients [17]. For this population, bowel dysfunction is the second most frequently reported complication and the fourth cause of rehospitalization [18]. In addition to the medical concerns these complications raise, they also have an adverse effect on quality of life, as they disrupt the ability to engage in normal daily activities and create social barriers.

Cardiovascular and metabolic complications

People with SCI experience coronary heart disease earlier than the general population [19]. They also are more likely to suffer insulin resistance, diabetes mellitus, and lower serum HDL ("good cholesterol") levels. Abnormal carbohydrate metabolism and lipid metabolism occur more frequently in this population than in mobile populations and are also associated with muscle atrophy and heightened adiposity.

Cognitive impairment

Those with SCI are 13 times more likely to suffer cognitive dysfunction than their healthy counterparts [11]. Research shows that as many as 6 or 7 in 10 of SCI patients will have some degree of cognitive impairment and that those with SCI appear to be at a heightened risk for Alzheimer's disease compared to those without SCI. One theory for the comorbidity of SCI and cognitive impairment is the potential for Traumatic Brain Injury (TBI) to have co-occurred at the time of SCI.

Psychological

Anxiety and depression frequently occur in those with SCI, which may be due to the substantial burden of SCI and the mental stress it imposes. Critically, some research suggests that psychological factors may dictate prognosis. Accordingly, successful psychological intervention in C4 dislocation patients has been shown to have a positive impact on quality of life as well as prognosis [20].

Skin breakdown

Skin breakdown, which may involve pressure injuries or burns, often occurs in SCI. SCI patients who develop chronic wounds have an increased risk of infections, sepsis, and death [21].

Other complications

In addition to the complications mentioned above, several other complications are often seen in SCI and further compromise health and quality of life. These complications include chronic pain, urinary tract infections, spasticity, deep vein thromboses, autonomic dysreflexia, hypotension, osteoporosis, and bone fractures [20,22].

If SCI occurs below C7, upper extremity function and posture are often spared. Because the phrenic nerve from C3 to C5 innervates the diaphragm, patients with injuries in those levels must be assessed for respiratory deficiencies. In these patients, upper and lower neuron injuries frequently coexist [10].

Because a greater extent of the body is affected, those with quadriplegia are at a higher risk for complications than those whose SCIs have led to other conditions, such as paraplegia [23]. For example, cardiovascular and respiratory systems tend to be more compromised in quadriplegics than in paraplegics [24]. Because quadriplegia patients are less likely than paraplegia patients to be capable of mounting fever and tachycardia, they may suffer worse outcomes if they develop sepsis [25].

QUADRIPLEGIA IS ASSOCIATED WITH POOR OUTCOMES

SCI pathophysiology is complex, as are the biological changes that occur in response to the injury [14]. As a consequence, treatment is challenging, and though acute care has progressed in recent decades, long-term care has not [14,26]. Because there is no treatment that fully restores the spinal cord following SCI, these injuries often lead to permanent disability and severe morbidity [2].

With no solid interventions, the recovery process following SCI relies largely on the formation of neural pathways based on synaptic plasticity in the nervous system [4]. Prognosis is thus quite poor, and SCI survivors experience a reduced life expectancy, which is, on average, 3.7 years [11]. Overall, younger victims of SCI recover better than those who endure SCI later in life [27].

Less than 1% of patients fully recover functioning before being discharged from the hospital following their injury [2]. However,

the recovery of strength in the first month following the injury is predictive on long-term outcomes with respect to recovering normal functioning [9]. Unfortunately, only about 12% of SCI survivors can maintain a job, and less than half of those who are single at the time of injury get married [2].

OUTCOMES CAN BE OPTIMIZED BY ENSURING PROPER TYPE AND LEVEL OF CARE

The complications and potential dysfunction in other organ systems that occur in quadriplegia place these patients at a high risk for morbidity in addition to reducing their quality of life [26]. As such, ongoing care and rapid interventions are critical to optimizing outcomes in this patient population.

Medical professionals with the relevant credentials can often identify complications that may arise in each quadriplegia patient because these complications are related to specific physical, psychological, and environmental factors [28]. Experts suggest that though medical care can prevent SCI patients from dying from complications within the first few years following their injury, care is not currently properly deployed to optimize SCI outcomes [29]. It is critical to fill this care gap to improve health outcomes and longevity and to reduce suffering and health-related costs.

For quadriplegia patients, who are particularly vulnerable and at increased risk for complications such as deep vein thrombosis, pulmonary emboli, urinary tract infection, cellulitis, and osteomyelitis, as well as auto-dysreflexia when the injury occurs above C6, licensed healthcare professionals are critical [30]. Specifically, regular monitoring by Registered Nurse (RNs), Licensed Practical Nurse (LPNs) or Licensed Vocational Nurses (LVNs) can help to stave off complications and to adequately address them when they arise to prevent premature death or unnecessary suffering.

Research into care for those with tetraplegia has shown that only 14% of quadriplegia patients undergo surgical tendon transfer procedures despite up to 75% potentially benefiting from the surgery [31]. Critically, when asked about which functions they most want restored, quadriplegic patients most frequently report the desire for hand function restoration [32]. Thus, in addition to care associated with outcomes, there is also a gap in care that is responsive to their needs and preferences.

DISCUSSION

Quadriplegia is a complex disorder that is associated with long-term disabilities and poor outcomes. It increases the risk for several complications, which are associated with further morbidity and mortality. In addition, the acute care related to these complications accounts for a large proportion of health costs associated with SCI [33]. Thus, preventing these complications or addressing them before they require hospitalization can both improve outcomes and reduce costs.

The impact of quadriplegia resulting from SCI is profound, affecting various aspects of an individual's life and health. Adequate and specialized care, focused interventions, and a better understanding of patient needs are crucial to improving outcomes, enhancing quality of life, and reducing the burden faced by quadriplegia patients. Addressing these challenges will not only optimize outcomes but also mitigate suffering and reduce healthcare-related costs associated with quadriplegia.

CONCLUSION

There is evidence to show that outcomes can be improve and costs can be minimized if proper care is deployed for quadriplegia patients. However, data also demonstrate that care is not meeting this potential. Determining the specific needs of each quadriplegia patients and ensuring they have the right type and level of care is the best way to support these patients, their families, and the broader healthcare system.

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