Spinal cord injury and Sexual health

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ABSTRACT

The estimated global incidence of spinal cord injuries is 10.5 cases per 100.000 people. Apart from the motor and sensory damage, spinal cord injuries affect the patients' sexual function and sexual activities. Arousal, erectile function, orgasm and fertility are the main somatic factors that are affected by the spinal cord injury. In addition, spinal cord injury patients show a higher rate of body image issues as well as psychological issues (anxiety, depression, post-traumatic stress disorders) which interfere with their sexual activities and lower their sexual satisfaction. Since there is no cure for spinal cord injury, therapeutic approaches related to the rehabilitation of sexual function mainly focuses on restoration of "normal" function. Pharmacological treatments and intracavernous injections for erectile dysfunction, body-exploration, assistive devices and sexual aids are some of the methods that healthcare professionals and patients can explore in order to improve sexual function and sexual satisfaction post-injury.

Key Words: Spinal cord injury, Sexual function, Sexual satisfaction, Sexual Health, Sexual dysfunction

Introduction

The term spinal cord injury (SCI) refers to any impairment of the spinal cord as a result of trauma, disease, degeneration or neoplasm. The estimated global incidence of traumatic spinal cord injuries is 10.5 cases per 100.000 people which leads to an annual number of incidences close to 768.473. Road traffic accidents and falls are the most common mechanisms of traumatic SCI and the number of incidences appears higher in countries with low and average income [1]. SCI affects the motor and sensory signal conduction across the site of the lesion as well as the autonomic nervous system. Injuries are classified as incomplete when there is sacral sparing (presence of motor and sensory function in the most caudal sacral segments) or complete (absence of sacral sparing) [2]. Apart from the damage on the motor and sensory function (extend of which depends on the level and the severity of the injury), the autonomic nervous system is also affected. Hemodynamic disorders, neurogenic bladder and bowel as well as sexual dysfunction are common impairments following SCI [3].

In able-bodied men arousal, ejaculation and orgasms are controlled by the sympathetic and parasympathetic nervous systems. Psychogenic erections and seminal emission are controlled by the T11-L2 sympathetic outflow, while reflexogenic erections are controlled by the S2-S4 parasympathetic outflow. In able-bodied women the sympathetic nerve fibers located at the thoracolumbar section are re-

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The process of identification and the criteria of inclusion-exclusion are described on the following flowchart (Table 1).

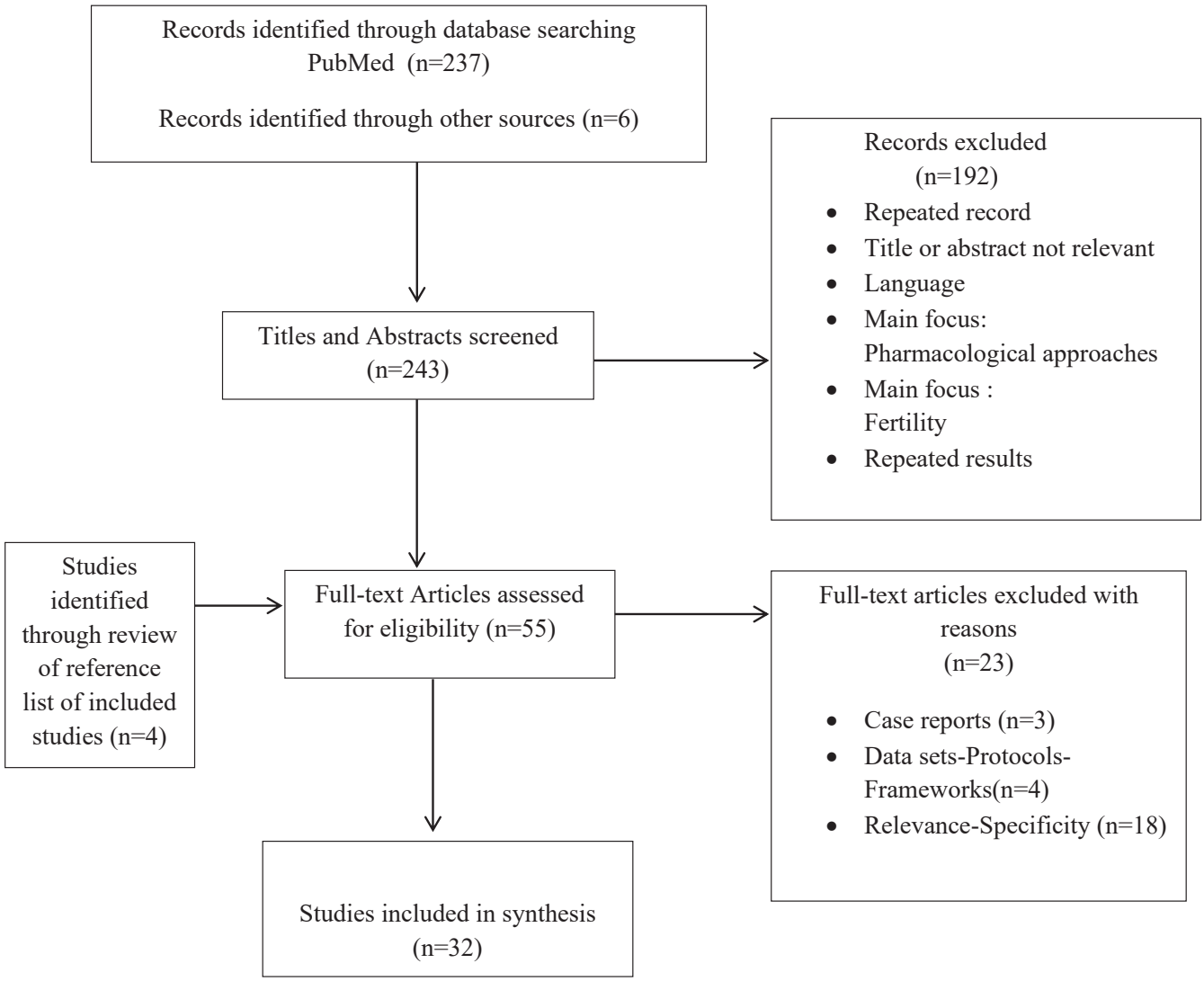

Table 1: Flowchart

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sponsible for psychogenic sexual arousal that leads to vaginal lubrication and clitoral enlargement, while reflexive sexual arousal is mediated by the nerve fibers of the pudendal nerve (S2-S4) and by the S2-S4 parasympathetic efferents [4]. Regarding orgasms in able-bodied men, orgasm is experienced as the result of cerebral processing of sensory information by the pudendal nerve which is caused by an increase of pressure in the posterior urethra [5], while able-bodied women experience orgasm as a variation of a transient sense of intense pleasure that creates an alternate state of consciousness and is accompanied by involuntary rhythmic spasms of the pelvic floor muscles combined with urethral and anal spasms and myotonia that completes the sexually induced vasoconstriction [6].

The current working definition of sexual health according to the World health organization is useful in better understanding the impact of SCI and is as follows: "A state of physical, emotional, mental and social well-being in relation to sexuality; it is not merely the absence of disease, dysfunction or infirmity. Sexual health requires a positive and respectful approach to sexuality and sexual relationships, as well as the possibility of having pleasurable and safe sexual experiences, free of coercion, discrimination and violence. For sexual health to be attained and maintained, the sexual rights of all persons must be respected, protected and fulfilled" [7].

According to Alavinia *et al*, sexual health constitutes a high priority area of rehabilitation for SCI patients [8]. For this reason, a review of the current literature was performed to identify ways that SCI interferes with patients' sexual health, function and satisfaction as well as the interventions that are being utilized in order to help patients achieve a better quality of sexual life. Pubmed database was used to identify studies, reviews and articles regarding the sexual health in people with SCI.

The key words "spinal cord injury", "sexual function", "sexual dysfunction", "sexual health", "sexual rehabilitation" and "impact" were used. Search parameters were specific regarding date of publication (from 2000 until 2020) and relevance. The process of identification and the criteria of inclusion-exclusion are described on the following flowchart (Table 1).

Discussion

The relationship between SCI and sexual health is being investigated for some years now. The impact that the injury has on the sexual health, function and satisfaction of patients depends on the age of the patient, the mechanism of injury (injuries that are caused by falls from heights have a more severe impact on the patients sexual life) as well as on the patient's goals and future aspirations. In a study by Taylan et al, patients with ASIA D classification reported lower levels of impact in the avoidance and impotence sub-section of the GRISS questionnaire while patients with ASIA A and B classification reported lower level of impact in the frequency, satisfaction, touching, anorgasmia and premature ejaculation sub-dimensions of GRISS [9]. Generally, the impact of SCI on patients' sexual function depends on the level and type of injury (complete or incomplete).

In men, the ability for reflexogenic, psychogenic and nocturnal erections is related to the level of the injury, the severity and type as well as the stage of injury and of the rehabilitation process [10]. More specific, reflex erections are more common in injuries above the L3-L4 level (given that the erection spinal reflex is intact) while psychogenic erections are more common in men where the level of injury is below the lumbar and sacral spinal regions and less common when the level of injury is at or above the T9 level and "co-exists" with disruption of the sympathetic flow [11]. Ejaculation follows a similar pattern and is more common in men with incomplete spinal cord injuries, while in men with upper motor neuron impairment the sexual stimuli are not enough to activate the spinal reflex arc of ejaculation [10]. There is also a high chance of entry disturbance of the sperm in the posterior urethra and a disruption in seminal expulsion (through the penile urethra and urethra orifice) which creates fertility problems to men with spinal cord injury [10].

Additionally, another aspect of sexual health and sexuality that is impaired is the ability to experience orgasms. Men with spinal cord injury have reported spasms, shivers, feelings of satisfaction and of impending ejaculation when asked to describe their orgasm experiences [12], while a study by Soler et al showed that men who can achieve anti-retrograde ejaculations had a higher chance of experiencing orgasms in com-

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parison to men who achieved reflex ejaculations [13].

The impact of SCI in women's sexual function is similar, with vaginal lubrication and vaginal blood flow being the main affected factors. The sympathetic cell bodies at the T11-L2 level control vaginal blood flow and the presence of an intact sacral spinal arc combined with a regulated psychogenic arousal are needed for sexual arousal and vaginal lubrication. Women with SCI experience higher levels of sexual distress and lack of vaginal lubrication compared to able-bodied women [14]. In addition, urinary and bowel incontinence, spasticity and autonomic dysreflexia result in higher levels of anxiety and lower levels of sexual satisfaction [15]. Orgasms are described as "harder to achieve" and lower in quality compared to pre-injury experiences [16]. In a study by Kreuter et al, regarding the experience of orgasm in 234 women with SCI, 8% reported no change in the quality of orgasm after injury, 25% reported pleasant and satisfactory feelings , 31% reported a feeling of relaxation, 3% reported unpleasant feelings and only 8% reported lack of orgasms after the injury [17]. Another aspect of the symptoms of the SCI that interfere with patients' sexual function is autonomic dysreflexia (AD). In patients with injuries at or above the T6 level, different sexual activities (with ejaculation being on the top of the list) have a higher chance of producing an AD episode. According to Courtois et al, a way to inhibit the appearance (or the effect) of AD is the use of nifedipine as a prophylactic and acute intervention [18].

It is worth remembering that the mental state of a person greatly affects his or her sexual life. Patients with SCI show higher levels of dysphoria and lower levels of satisfaction in comparison to healthy population. They also have a higher chance of developing depression, anxiety and post-traumatic stress disorders [19]. The psychological aspects of the injury can sometimes have a greater impact on patients' sexual adjustment post injury than the physical aspects [20]. The perceptual, cognitive, affective and behavioral dimensions of body image are also affected by SCI, according to a pilot study by Bailey et al. Besides that, the participants reported a strong need to be viewed as "normal" [21]. In addition, there are changes in patients' sentimental life following SCI. The most significant predictor regarding the quality of sentimental life, besides the overall quality of life, is the ability to drive a vehicle. It's not surprising that driving a vehicle grants a higher level of independence and can help a person seek a more active social life and engage in interpersonal relationships [22].

Interventions

As mentioned, sexual health is a high priority in terms of rehabilitation for people with spinal cord injuries. Before discussing the different types of interventions, it is important to highlight the role of healthcare professionals in the rehabilitation of patients' sexual function. New et al, conducted a study in a group of 175 people with traumatic and non-traumatic spinal cord injuries to record and compare their experiences regarding sexual education (as part of the rehabilitation process) as well as their preferred methods of delivery of this kind of information. Interestingly, people with non-traumatic spinal cord injuries ("spinal cord disease") were less likely to receive sexual education as part of the rehabilitation process. The preferred methods of information delivery were sexuality counselors, internet sites, peer support workers, staff discussions, DVDs, and written information. Based on their results, New et al, proposed a list of subjects that healthcare professionals should be able to discuss with their patients such as contraception, safe sex practice, sexually transmitted infections, self-esteem training, erogenous zones and options regarding non-intercourse sexual activity [23]. Regardless of the way and the medium that a healthcare professional chooses to discuss these subjects, the most important thing is to maintain respect for the patient's believes and needs. Sexuality is an intricate subject with a "heavy" psychological background. Phrases like "abandon sex", "sex is dead", "give it time" can do more harm especially in cases where patients have not received the necessary information regarding their sexual function and their sexual options post-injury. Every healthcare professional should possess the ability and basic knowledge to answer patients' questions regarding sexual function and activity and/or refer them to a specialist [24].

Starting with the pharmacological options, the use of phosphodiesterase type 5 inhibitors (pde5i) is considered the first line of treatment for managing erec-

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tile dysfunction. In men with SCI, pde5i drugs like Sildenafil, Vardenafil and Tadalafil improve erectile function as well as the overall sexual life quality due to their tolerance and ease of use. Soler et al, assessed the efficacy of ped5i in erectile dysfunction in 240 patients with SCI. 120 patients were on Sildenafil (Viagra), 54 patients were on Tadalafil (Cialis) and 66 patients were on Vardenafil (Levitra). 85% of patients on Sildenafil, 74% of patients on Vardenafil and 72% patients on Tadalafil reported improvement in penile rigidity ("enough for penetration"). It is important to note that according to Shridharani et al, in men with cervical or high thoracic injuries the use of pde5i can lead to dizziness. Furthermore, on the subject of ped5i use in SCI patients Alexander et al, in a double-blind placebo control flexible dose study assessed the efficacy, safety and tolerability of per os Sildenafil in 129 women with sexual arousal disorder due to SCI. They reported a similar improvement in sexual activity in both the active and placebo group noting the absence of clinical relevance of Sildenafil in women with spinal cord injury [25-27]. In cases where the use of per os ped5i drugs is not well tolerated or effective, administration of intracavernous injections is another option that physicians and patients can explore. In a systematic review and meta-analysis of 283 studies involving 713 patients with SCI Chochina et al, reviewed the efficacy of intracavernous injections and reported that in 88% of the population intracavernous injections led to successful erections using either a combination of papaverine and phentolamine, papaverine alone or alprostadil [28].

In terms of non-pharmacological and non-invasive approaches there are some data that indicate that the use of vacuum devices and/or restrictive rings can improve erections under the right circumstances (intact reflex arc) in combination with other treatments [29]. Focal vibrations are also a non-invasive option that men with incomplete SCI can explore. According to a study performed by Calabrò et al, the use of focal vibrations in the pelvic floor (using a pneumatic vibrator) in 10 men with incomplete SCI (ASIA C-D) resulted in improvements on the IIEF (international index of erectile function) and MAS (modified Asworth scale) scores, improved cremasteric and bulbocavernosus reflex responses as well as an increase in the pudendal somatosensory evoked potential and in the electorophysiological bulbocavernosus reflex. The authors also noted that muscle vibration can lead to reduced spasticity and improved muscle synergies through both bottom-up (reset of sensimotor hyperexcitability from sensory inputs) and top-down mechanisms [30].

On the subject of ejaculation and orgasms, the two most well-known methods are penile vibration stimulation (PVS) and electo-ejaculation (EEJ) which also facilitate sperm retrieval for fertility purposes. In 2010, Bracket et al published their results after evaluating 3152 sperm extraction interventions from 500 different men with SCI and noted a 54% success rate when using the PVS method (in 461 patients) and a 91,9% success rate when using the EEJ method (in 210 patients) [31].

Moving on to more invasive and surgical interventions that aim to restore sexual function in men with SCI, penile prosthesis is the oldest and perhaps the most known procedure that aims to restore erectile function in men with SCI, although it carries a fair amount of risks and complications (mainly due to corrosion of the device and infections) [32]. Another invasive approach that can be explored by men is sacral neuromodulation, a procedure that was first introduced for the management and rehabilitation of neurogenic bladder. A neurostimulator that is implanted through the S3 foramen sends an electrical pulse to the sacral plexus resulting in improved erections. In a study by Lombardi et al, 52 men suffering from lower urinary tract symptoms and concomitant erectile impairment were selected and evaluated for sacral neuromodulation (29 out of 52 patients had neurogenic erectile impairments including incomplete SCI patients). The authors reported a clinical improvement and maintenance of improved erectile function in 35.7% of the neurogenic subjects [33]. For men with injuries below the L2-level there is also the option of the TOMAX procedure which involves a microsurgical connection of the sensory ilioinguinal nerve to the dorsal nerve of the penis unilaterally and aims at restoring tactile and erogenous sensitivity in the penile glans. In 2012, Overgoor et al published their results after performing the TOMAX procedure in 30 patients with no penile sensation but good groin sensation (Spinal bifida: 18 patients, Spinal cord injury: 12 patients). The authors

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noted an 80% improvement in unilateral penile glans sensation leading to improvements in urinary continence, independence, and sexual life [34].

Regarding the restoration and rehabilitation of sexual function and sexual health in women with SCI, the first step is encouraging the exploration of different methods of stimulation (beyond clitoral stimulation) such as stimulation of the vagina (G-spot) and stimulation of the cervix and the nipples [35]. Vibratory stimulation devices (VS) as well as clitoral vacuum suction devices (CVS) have shown great results in facilitating orgasms. According to Alexander et al, in a population of 23 women with orgasmic dysfunction (18 with multiple sclerosis and 5 with SCI) both methods are safe and effective with the difference that CVS results in an overall improvement of the sexual function (which was maintained for 4 weeks after treatment) whereas VS results in improvements only in orgasms and only during active treatment [36]. Finally, in a recent study Zimmerman et al, reported increase in vaginal blood flow in lab-rats supporting the already proposed theory that tibia nerve stimulation can be considered as an alternative approach in the rehabilitation of sexual arousal disorders in women [37].

Regardless of the person's anatomy and chromosomes, everyone should be encouraged to explore their body, different positions and sexual aids/devices in order to maximize sexual satisfaction. One of the most inclusive and educational manuscripts (for patients and medical professionals) regarding the sexual activity and sexual life of patients with disabilities is the "Pleasure-able: Sexual device manual for persons with disabilities" by Krassioukov et al. It addresses matters such as anatomy, safety, lubrication, positioning, lubrication, sexual aids etc. while being sex positive and inclusive to persons of all abilities, genders, age, race and sexual orientation [38].

Conclusion

The impact of SCI in a patient's life is not determined only by the motor and sensory impairment. Sexual function is also affected (directly or indirectly) and can sometimes have a greater impact in a patient's quality of life. Men encounter difficulties in achieving and/or maintaining erections and orgasms while women encounter difficulties due to lack of vaginal lubrication and lack of vaginal blood-flow. Regardless of the patient's sex, the psychological effects of the injury indirectly affect their sexual function, health, satisfaction and their sexuality. Depression, anxiety, sexual distress, and body-image issues have a higher prevalence in people with SCI and lead to lower self-esteem and lower satisfaction in sexual and sentimental life. Healthcare professionals should be ready to educate and address patients' concerns regarding sex, orgasms, and fertility and either help in creating a rehabilitation protocol (that fits patient's needs) or refer them to a specialist. With the use of pde5i drugs (Sildenafil, Vardenafil or Tadalafil per os or via intracavernous injections) in combination with body-exploration, sexual aids and devices (vacuum devices, vibrators, restrictive rings) and different positions or with the use of more invasive approaches (like the TOMAX procedure or sacral neuromodulation) a patient's sexual life can really be improved. It is important to keep in mind that every person requires a different approach and moves in a different pace. Further studies regarding the impact of SCI in sexual health and sexuality as well as the possible interventions (for example the potential use of electric nerve stimulation) are needed in order to further improve the overall quality of life of people with SCI.

Conflict of interest

The authors declare no conflicts of interest.

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