

We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,900

Open access books available

186,000

International authors and editors

200M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com



Erectile Dysfunction in Paraplegic Males

Charalampos Konstantinidis
National Institute of Rehabilitation
Greece

1. Introduction

In the U.S. there are over 300,000 people who suffer from spinal cord injuries. This incident increases every year by 10,000 to 12,000 new patients (Harrop et al., 2006). In Canada, about 36,000 people live with spinal cord injuries, while 55% of them, are people in the reproductive phase of their life, aged 16-30 years, and the ratio of men to women is calculated to 4 /1 (Mittmann et al., 2005). For several years there was a myth in societies that people with paraplegia or quadriplegia have no sexuality, do not have erectile function and that they are infertile. In fact, sexual expression is a component of personality and it is independent to the erectile function or fertility status. In handicaps lack of sexual interest is associated with social withdrawal and inability to recover while sexual alertness is associated with faster and better recovery. The degree of sexual rehabilitation is directly related to physical rehabilitation, social integration and quality of life (Biering-Sorensen & Sonksen, 2001; Fisher et al., 2002). Last years the medical community emphasizes on quality of life and sexuality of people with spinal cord injuries. It is shown that the 66% of patients with spinal cord injuries consider their erection sufficient for sexual activity. The incidence of injury on the person's sexual function depends on the location and the extent of the damage. After Spinal Cord Lesions (SCL), both men and women are reporting decreased desire and low frequency of sexual activity (Deforge et al., 2006).

2. Pathophysiology of Erectile Dysfunction (ED) after SCL

Erection is a neurovascular phenomenon which takes place under neuro-hormonal control. Sensory data from the eyes and skin are relayed to certain areas within the hypothalamus where appropriate signals are relayed to the penis. The upper centers which regulate the erectile function in the brain are located at the cortex and the hypothalamus, as mentioned above. The main involved nuclei are: paraventricular nucleus, medial preoptic area, paragigantocellular nucleus, and locus coeruleus. The lower centers are located in the spinal cord. These centers are two: the psychogenic, sympathetic erection center which is located at the Th11-12 until L2-3 level of spinal cord and the reflexogenic, parasympathetic erection center which is located at the S2-4 level of spinal cord. The sympathetic erection center is purely autonomous, contains fibers with evoked and others with inhibitory action and travels with the inferior hypogastric plexus. The parasympathetic erection center contains also somatic fibers. The afferent fibers are coming from the pudendal nerve and the dorsal penile nerve, while the efferent fibers involve in the formation of the cavernous nerves and the inferior hypogastric and sacral plexus. Sympathetic innervation provides inhibitory

pathways whereas parasympathetic and somatic innervations are crucial for erection. The two centers of the spinal cord are under the control of the brain (Saenz de Tejada et al., 2005).

Erection can be distinguished to reflective and psychogenic according to the origin of its induction and the erection center which is mainly involved. Reflective erection is the outcome of somatoaesthetic stimulation and may be independent of sexual arousal. This erection takes place through the reflexogenic, parasympathetic erection center. Psychogenic erection, which predominates in humans, is the result of sexual desire caused by images, fantasies and thoughts related to previous sexual experiences. The psychogenic, sympathetic erection center is mainly responsible for this kind of erection. The erectile function in patients with SCL depends on the location of the injury and the extent of the lesion. In patients with upper cord lesions, reflexogenic erections are preserved in 95% of them, while in patients with complete lower cord damages this rate is only 25%. The quality of erection is better as higher the lesion is located (Eardley & Kirby, 1991). Derry et al., in their study are reporting that 25% of men with SCL regain their erectile function one month after injury, when 60% and 80% regain their erections in a period of six months and one year respectively after injury (Derry et al., 2002). The preservation of the sacral parasympathetic neurons leads to the maintenance of reflexogenic erection. In case of sacral injury thoracolumbar pathway may take over through synaptic connections. In general, men with cervical and thoracic lesions regain their erections sooner and better than men with lumbar lesions (Courtois et al., 1993).

Reflexive erections, which require the integrity of parasympathetic erectile center (S2-4), have been observed in people with SCL. These arise after irritation of the skin or mucosa below the level of the lesion. Manipulations such as rubbing of the thighs or nipples, squeezing of the glans, suprapubic percussion, irritation of the anal region, proved to be more effective than masturbation or any other stimulation of the genitalia (Saenz de Tejada et al., 2005; Derry et al., 2002). Lesions higher to Th11 level are combined with erection of both corpora cavernosum and corpus spongiosum, while lesions below this level exclude the participation in the erection of the corpus spongiosum (Biering-Sorensen & Sonksen, 2001). This erection is usually sufficient for penetration, but it has short duration. The reflexive erections maintain in 95% of patients with total damage over the sacral center, while in lower level lesions this percentage is up to 25%. The training for the challenge of this reflex is part of the sexual rehabilitation.

Psychogenic erections have been observed in 60% of patients with intact sympathetic erectile center (Th11-L2) and lesion below the L2 level. Psychogenic erections, as mentioned above, are independent from direct physical stimulation and are the result of visual or acoustic stimuli, dreams, fantasies or memories. These erections are usually with low quality and short duration. Objectively, it is more of a swelling of the penis rather than a hard erection, rarely allowing penetration (Derry et al., 2002; Courtois et al., 1999; Smith & Bodner, 1993; Chappelle et al., 1980).

Mixed erection occurs when the SCL is between the two centers. These erections onset after a psychic stimulus and maintain or even are enhanced by a physical stimulus, or they are prolonged reflecting erections which are enhanced by a strong sexual desire.

Nocturnal erections have been also recorded in men with SCL. These erections usually take place during the REM phase of the sleep. The comparison between the erections of quadriplegic and paraplegic patients showed that quadriplegic men had better erections (regarding hardness and duration) than paraplegic patients. Additionally, thoracic spinal lesion was associated with poor nocturnal erections comparing with cervical spinal injuries (Suh et al., 2003).

Patients with lesions above the Th6 level often present the phenomenon of autonomous dysreflexia, which involves reflecting increased sympathetic tone at the level below the lesion. This increased sympathetic response causes vasoconstriction and hypertension. At the levels higher to the spinal lesion, vasodilatation takes place and causes flashing and headache. The more serious symptom is the parasympathetic activation which decreases the heart rate. This situation with excessive hypertension and bradycardia is dangerous for the patient and it was found that sexual arousal may trigger dysreflexia. In these cases sexual activity must be avoided (Rossier et al., 1971; Frankel & Mathias, 1980).

3. Diagnostic approach to patients with SCL

3.1 Sexual history

Sexual history is the first step in the evaluation of patients with ED. Our purpose is to assess the pre-injury and the post-traumatic sexual function and to identify the ED. The absence or presence of erections, under what circumstances they took place, the number and the frequency of them, the quality of erections (regarding hardness and duration) compared with the erectile function before injury and the frequency of sexual intercourse, are some of the questions which have to be answered. Additionally, a good history will assess the mental and psychological status of individuals whereas ED with psychogenic origin described in 10% of men with SCL (Monga et al., 1999; Tay et al., 1996).

3.2 Physical examination and laboratory tests

Physical examination reveals clinical signs which contribute to the diagnostic approach of ED. During the examination of the external genitalia, neurological examination should also be included. Our aim is to identify the level of lesion, according the sacral and the thoracic-lumbar origin of the neurosis of external genital organs. Assess of the sensation of the genitalia, the perineum and the perianal region as well, is essential for the evaluation of parasympathetic erectile center, as the somatic-sensation of these areas reflects to the S2-4 level of the spinal cord. By evaluating the reflex of the cremaster muscle, we can assess the S1-2 reflex arc. By evaluating the reflexes of rectus muscles, we can assess the Th9-12 reflex arcs and the bulbocavernous reflex is suitable to investigate the integrity of S2-4 reflex arc (Vodusek, 2003). Additionally, tendon reflexes of the lower limbs can evaluate the lumbar region of spinal cord.

Apart from control of reflexes, the use of specific neurological tests has been reported in the literature. The measurement of latency time of the bulbocavernous reflex by placing electrodes on the penis and the bulbocavernosal muscles and the measurement of somatosensory cortical evoked potentials by placing electrodes on the scalp, may give an accurate assessment of the nervous lesions (Bird & Hanno, 1998).

3.3 Nocturnal Penile Tumescence and Rigidity (NPTR)

The recording of nocturnal erections in normal subjects is a method for the differential diagnosis of psychogenic from organic erectile dysfunction. The recording of these erections, usually during REM phases of sleep, is made by the Rigiscan (Fig. 1). Rigiscan uses two inflatable rings which are adapted at the base and at the tip of the penile shaft. These rings work as sensors for the increase in the diameter (tumescence) and the hardness during erection. The duration and the quality of these erections represent the erectile capacity of the patient. The findings must be confirmed for at least two nights.



Fig. 1. Rigiscan device uses two inflatable rings which act as transducers in order to study the tumescence and the rigidity during erectile episodes.

Rigiscan studies have shown that the onset of erection does not appear to require intact pathways from the brain towards the spinal cord, while nocturnal erections were observed in men with complete SCL (Suh et al., 2003). Rigiscan studies showed that men with SCL do suffer from psychogenic ED at a rate of up to 10% (Tay et al., 1996).

3.4 Dynamic Doppler Ultrasound Evaluation

Dynamic Color Doppler ultrasound tomography is a method which can evaluate the vascular potential of the corpora cavernosa and can assess the hemodynamic of the penis. After the administration of vasoactive drugs (intracavernous injection of alprostadil 10 μ g), blood flow is studied by measuring the peak-systolic and the end-diastolic velocity (Fig.2). According to these findings, vascular etiology (low arterial inflow or venous escape syndrome), of erectile dysfunction can be identified.

In cases of neurogenic ED, ultrasound findings are usually normal, as the majority of these patients, is young with no vascular pathology. If a reduced blood supply of the cavernous

artery is present, probably this occurs due to concomitant vascular inefficiency (Kim et al., 2006). Normal reply to vasoactive drugs is described in 80% of patients with SCL, while there are some other studies which record high rates of vascular lesions in these patients (Robinson et al., 1987).

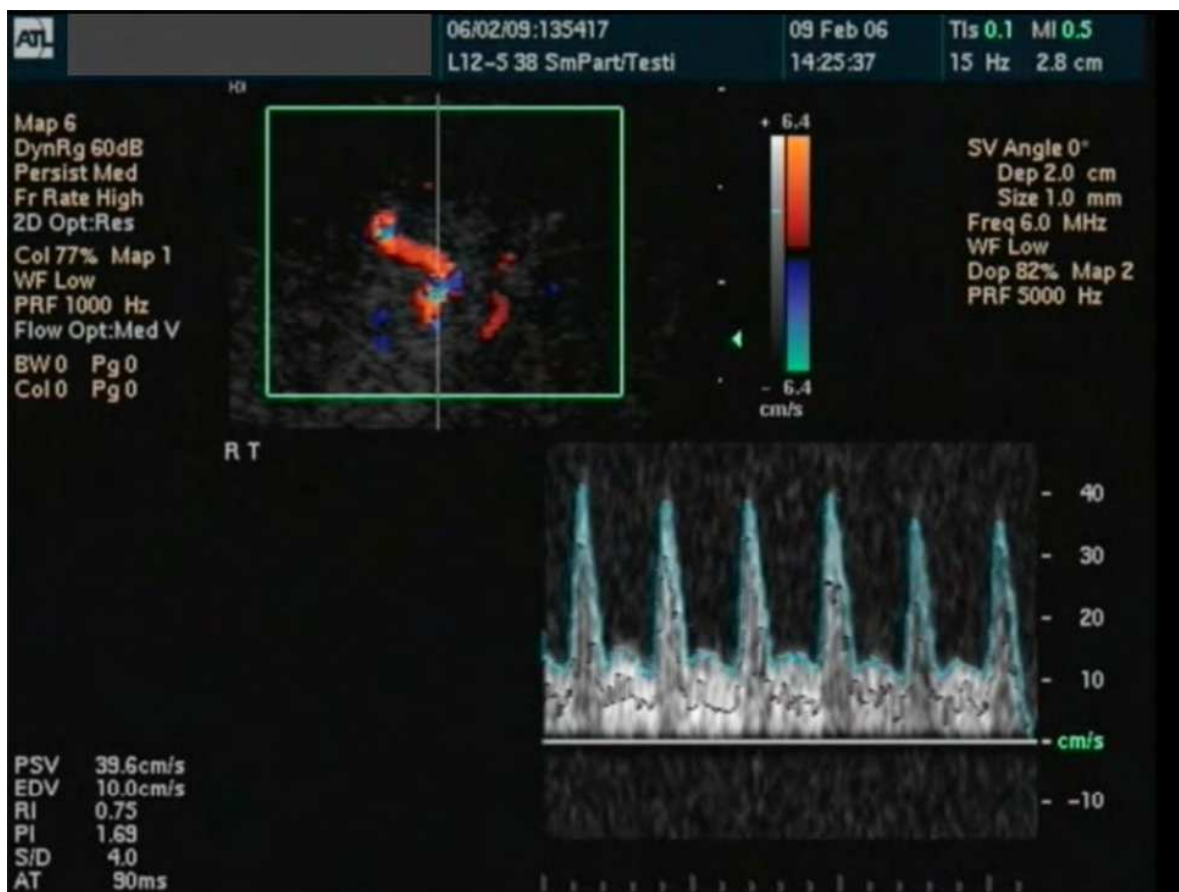


Fig. 2. Color Doppler ultrasound, 10 minutes after intracavernous injection of 10 μ g alprostadil. Due to high End-Diastolic Velocity (EDV) this is an image of venous escape syndrome.

4. ED treatment in men with SCL

The treatment of ED in paraplegic or quadriplegic patients follows the therapeutic strategy of any other case of organic ED. According to that, we can apply stepped treatment of 1st, 2nd and 3rd line. The 1st line of treatment includes oral inhibitors of phosphodiesterase type 5 (PDE-5) and vacuum devices. In the 2nd line of treatment there are penile injections and transurethral application of vasoactive substances. Finally, in the 3rd line of treatment option there is the implantation of penile prosthesis (Ramos & Samsó, 2004). Patients should be informed about all the treatment options from the beginning of the therapy, although the treatment is applied step by step. This is very important for neurogenic patients in order to be optimistic for the outcome of the treatment. General considerations regarding blood pressure, lipid profile, hormonal status, diabetes mellitus and stop smoking are necessary to all patients with ED. On the other hand, most of the patients with SCL are young men with excellent sexual function before injury and the etiology of their ED is mostly neurogenic. In

these patients psychogenic component is present sometimes and other organic causes, vascular inefficiency for example, occur rarely.

4.1 First line treatment

4.1.1 Oral treatment

Since sildenafil gained the approval of use, it has proved its efficiency against ED, of any organic reason. The efficacy and its safety have been demonstrated in studies in patients with SCL. In bibliography there are two relevant, randomized, prospective, multicenter placebo controlled studies. Giuliano et al. studied 178 patients with SCL and indicated 76% efficacy of sildenafil compared with 4% of placebo (Giuliano et al., 1999). In another similar study by Maytom et al. (with only 27 patients) it was referred efficacy in sildenafil 65% vs. 8% in placebo (Maytom et al., 1999). In the same study the overall satisfaction with their sexual activity reported in 75% in the sildenafil group compared with 7% in the placebo group. In a meta-analysis of eight other studies it was indicated the overall effectiveness of sildenafil in 80% of these patients (Deforge et al., 2006). Derry et al. reviewing the literature indicates that the proportion of patients with SCL showing improvement in their erectile function reaches 94%. The majority of them (72%) indicate successful sexual intercourse, as well. Response rates were generally higher in patients with partial section of the spinal cord (incomplete lesions). However, a significant proportion of patients with complete cross-section, regardless of the location of the lesion, benefited from the administration of sildenafil (Derry et al., 2002; Sanchez Ramos et al., 2001). The existing literature, thus, demonstrates high efficacy and safety of oral treatment with sildenafil in patients with ED after SCL.

There are at least two studies in the literature supporting the efficacy of vardenafil in the treatment of ED for patients with SCL. Giuliano et al. in a multicenter, double-blind and placebo controlled study, with duration of 12 weeks, which included 418 patients, reported erections, sufficient for penetration in 76% of patients in the vardenafil group, compared with 41% of patients in the placebo treatment group (Giuliano et al., 2006). In the same study, 59% of the vardenafil group indicated satisfactory duration of erection, compared to 22% of the placebo group. Another open label study, without control, dealing with vardenafil administration in SCL patients, based on 38 patients, indicated achievement of erection, efficient for penetration in 83% of patients and duration of erection satisfactory for 88% of those (Kimoto et al., 2006).

Regarding tadalafil, there is a comparative study by Del Popolo et al. between sildenafil and tadalafil in patients with ED and SCL (Del Popolo et al., 2004). This was a randomized, blind; cross-over study with 15 patients in each arm and duration of 12 weeks. The study indicated that tadalafil allowed to the majority of patients to achieve a satisfactory erection for up to 24 hours after the administration of the drug, but this was due to pharmacokinetic of tadalafil. Additionally, an improvement of sexual satisfaction of both patients and their sexual partners has been recorded in both groups (sildenafil and tadalafil). In another multicenter, randomized, placebo-controlled study by Giuliano et al. was reported statistical significant improvement, to the tadalafil group, at the erectile function domain of the IIFF questionnaire and at the questions 2 and 3 of the Sexual Encounter Profile (SEP) which

regards the achievement of sufficient erection and satisfactory intercourse (Giuliano et al., 2007). These findings were confirmed by another study by Lombardi et al., that reported improvement at the IIFF score and at the ability to achieve an efficient erection (SEP 2) and a satisfactory intercourse (SEP 3), in patients with SCL after the appropriate dose of tadalafil (Lombardi et al., 2008).

There is a comparative study of all PDE-5 inhibitors in patients with SCL which was published in 2007 (Soler et al., 2007). The study consisted of three groups of patients, according the PDE-5 inhibitor which was used. In the group of sildenafil there were 120 patients, in the group of vardenafil there were 66 patients and in the group of tadalafil there were 54 patients. Initially all patients received the lower dose of each drug and there was dose up regulation until the efficacy was sufficient. The overall efficacy was similar for all the drugs (85% for sildenafil, 74% for vardenafil and 72% for tadalafil). The duration of erections was also similar for all (26 - 34 minutes). The higher dose of the drug required in 45% in the group of sildenafil, compared with over 70% of the patients in the other two groups. In another meta-analysis of 18 studies, regarding PDE-5 inhibitors in men with SCL was reported statistical significant improvement of erectile function compared to placebo in 11 studies (Lombardi et al., 2009). The overall amount of patients was 705 in sildenafil, 305 in vardenafil and 224 in tadalafil. Only 15 patients stopped treatment due to adverse events. This meta-analysis came to the conclusion that the relatively small amount of patients and the different methodology of the studies do not allow reliable comparisons between the drugs. On the other hand, there is enough data in the literature supporting that PDE-5 inhibitors are safe and effective treatment option for the ED of men with SCL.

4.1.2 Vacuum devise

The use of vacuum device is an alternative treatment option for the ED of people with SCL, with satisfactory efficacy (Zasler & Katz, 1989; Heller et al., 1992). The vacuum device is a cylinder with an open edge. The penis is placed through the open edge inside the device and by pumping; vacuum is created inside the cylinder. The negative pressure forces the blood to fill the corpora cavernosa, causing erection. After erection a ring which is placed tight around the base of the penis is necessary for the maintenance of the erection (Fig. 3).

Efficacy and complications of these devices were studied in 20 patients and their partners (Denil et al., 1996). After 3 months of use, 93% of men and 83% of women reported erections sufficient for vaginal penetration which lasted for about 18 minutes. After 6 months, however, only 41% of men and 45% of women were satisfied with the use of vacuum device. The most unpleasant fact was the early loss of the rigidity of the erection. Overall, 60% of men and 42% of women reported improvement in their sexual lives by using the vacuum device. Finally, adverse effects such as bruising or swelling and even gangrene of the penis have been recorded (Rivas & Chancellor, 1994). The higher complication rate of vacuum device in men with SCL has to do with the absence of sensation in the area, so a very tight ring remaining for a long time can cause tissue ischemia and necrosis without any pain or disturbance. The appropriate advice for the people using the device is to be careful with the overall use and to avoid the very high negative pressure and the long-lasting strangle of the penile shaft.



Fig. 3. The vacuum device is a cylinder with an open edge. The penis is placed through the open edge inside the device and by pumping; vacuum is created inside the cylinder.

4.2 Second line treatment

4.2.1 Intracavernous injections of vasoactive substances

Men with ED after SCL respond very well to intracavernous injections of vasoactive substances (Hirsch et al., 1994; Deforge et al 2006). This happens, because most of these people are young, with small likelihood of an additional vascular disease. The technique is simple and relatively painless. The high effectiveness of the injections in combination with the absence of sensation at the penis makes this choice friendlier to paraplegics. The injection takes place between the 1st and 3rd or between the 9th and 11th hours of the penile shaft (Fig. 4). A gentle massage of the area helps the drug to be absorbed. The erection begins five to ten minutes later and it is independent from any sexual arousal.

Most studies report high rates, which reach 95% response to vaso-active substances such as papaverine and alprostadil (Lebib Ben Achour et al., 2001; Dietzen & Lloyd, 1992). Side effects and complications described in the literature are: priapism, skin bruises and cavernosal fibrosis. Papaverine is responsible for higher rates of priapism and fibrosis than alprostadil. Patients with SCL develop priapism more often, maybe due to excessive release



Fig. 4. The injection takes place between the 1st and 3rd or between the 9th and 11th hours of the penile shaft, after penile stretching.

of neurotransmitters which promote erection or due to sympathetic hypertonia. For these reasons in the beginning of the treatment lower doses of vasoactive drugs are used and the dose is entitled for each patient. In a meta-analysis of other studies, there was an overall rate of men with satisfactory erections reaching the 90% of the users of intracavernousal injections (DeForge et al., 2006). In another study there was a comparison between the use of vacuum device and the administration of injections of papaverine (Chancellor et al., 1994). Eighteen men with SCL participated in this study, which was cross-over designed. After both treatment options, half of the patients chose injections and half of them chose vacuum device.

4.2.2 Urethral administration of vasoactive substances

The communication between the corpora cavernosa and the corpus spongiosum was the base for the intra-urethral application of vasoactive drugs. Alprostadil (PGE1) has been used for this purpose. The way of action is the same to intracavernousal injections, without needles and punctures. There is an applicator which places the drug into the urethra (Fig. 5). The overall efficacy rate is reported at 65.9% of 995 men with ED (Padma-Nathan et al., 1997).

In patients with SCL the outcome was not as satisfactory as using intracavernousal injections (Bodner et al., 1999). Regarding adverse events, systemic absorption of alprostadil was responsible for hypotensive episodes. The use of a tight ring at the base of the penis is essential in order to avoid this rapid absorption and to maintain the achieved erection.

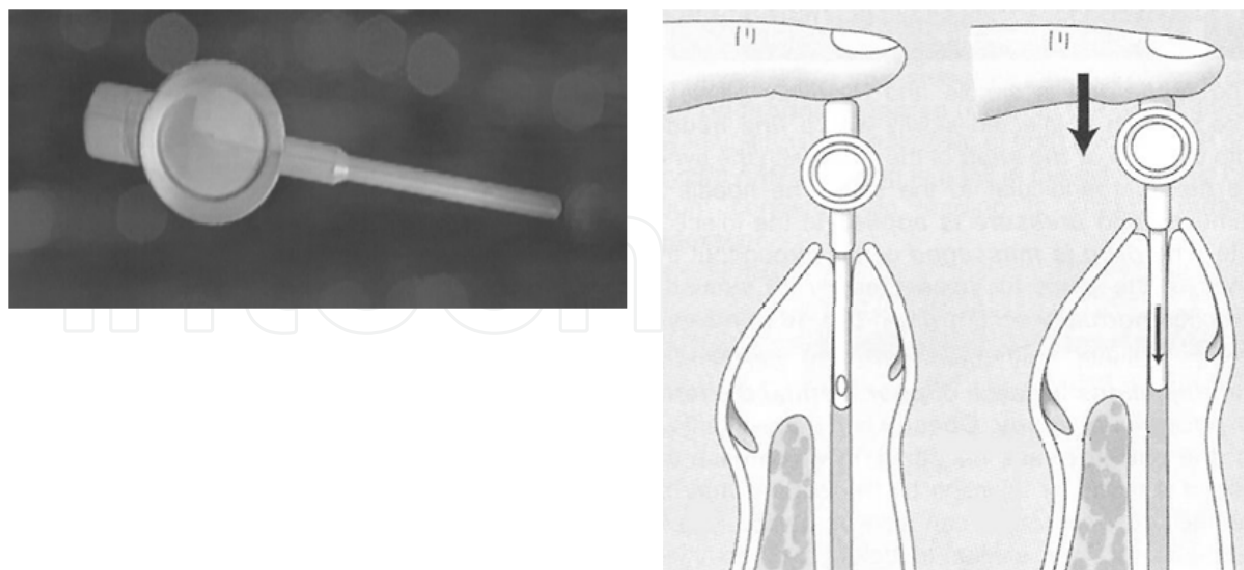


Fig. 5. For the intra-urethral placement of alprostadil a specific applicator is used.

4.3 Third line treatment

The implantation of penile prosthesis is the 3rd line treatment and represents the surgical option for the management of ED. The prosthesis can be malleable or hydraulic. Hydraulic one may consist of two or three pieces (Fig. 6). The application of penile prosthesis in men with SCL accompanied with a high rate of complications, as it was indicated in some older studies (Dietzen & Lloyd, 1992). In these series it was reported mechanical damage in 43%, infection in 37%, erosion in 10% and hematoma 7% of patients. An overall complication rate of 13.3% was also reported in another study (Kimoto & Iwatsubo, 1994).

As the prosthesis models become more contemporary the results improve as well. In a relatively recent study a total number of 245 patients with SCL participated (Zermann et al., 2006). Apart from the restoration of erectile function, penile prosthesis implantation offered a wide enough penis in order to achieve a better fixation of a condom catheter. Regarding erectile function, 82.6% of men and 67.5% of their sexual partners reported the treatment as successful. Complication rate was lower than in older studies. It was reported infection in 5%, and erosion from 0 to 18% depending on the type of prosthesis (none for the three pieces inflatable ones and 18% for the malleable types). In a meta-analysis based on five previous studies where prostheses were implanted in patients with SCL, serious complications were reported in 10% of the cases. On the other hand, patients who experienced no complications were very satisfied (Deforge et al., 2006; Xuan et al., 2007). The higher complication rate which is reported in paraplegics, compare to ambulant, impotent patients probably has to do with the absence of sensation which may lead to excessive use of the prosthesis which is compressing the glans and the other tissues, causing ischemia. This is the first step for erosion. Generally speaking, a penile prosthesis improves the quality of life of patients with SCL significantly; however, erosion and infection are still remarkable problems.



Fig. 6. On the left: a malleable prosthesis (one of the two cylindrical pieces); on the right: a three pieces inflatable prosthesis with some of additional tips. You can distinguish the cylinders, the pump and the reservoir.

5. Therapeutic strategy

The accurate diagnostic for SCL is crucial for choosing an adequate treatment. The level, the extension and the total or partial character of the neural damage may drive to one or other treatment option. Generally, patients with partial section of the spinal cord will respond better to oral or topical treatments. It has been also proven that oral pharmacotherapy with PDE-5 inhibitors is more effective if at least one of the erection centers has maintained. At the begging, PDE-5 inhibitors were used in patients with intact S2-4 reflex arc, which indicated the integrity of parasympathetic erection center. Later on, it was found that this kind of pharmacotherapy is also effective in patients who did not appear any spontaneous erectile function. In general, patients with lesions at higher levels respond better to oral therapy.

The use of vacuum device and penile injections require skill on behalf of the patients. Tetraplegic patients face more difficulties in the appliance of these therapies, which are possible only by the partner's contribution. If the patient is a condom catheter user due to incontinence, penile prosthesis may offer a solution for both erectile dysfunction and incontinence, by supporting a better fixation of the condom catheter.

In our center we use an algorithm for the management of ED in paraplegics. This is described below: If the patient has residual (spontaneous or induced by sexual arousal) erection, which is, in general, not sufficient for vaginal penetration, vacuum device and/or oral pharmacotherapy with PDE-5 inhibitors are offered. If the patient is not satisfied we apply intracavernousal injections of vasoactive drugs, alprostadil in most cases. At this point the majority of our patients is satisfied. In cases that there is fibrosis of the cavernosal tissue, usually after recurrent priapism episodes, penile prosthesis remains the only reliable choice for the management of the ED of these men. The implantation of the penile prosthesis is the ultimate therapeutic option with excellent results. Finally, it has to become clear to all patients that the above treatment options are suitable for the ED and do not solve the ejaculation or/and orgasm disorders they might experienced.

The role of sexual partner is very important as the partner must be part of the therapeutic option. The couple has to "open its mind" regarding the sexual activity. They must compromise, at the beginning, and finally, regulate their sexual lives in a status that penetration is not the main sexual activity.

6. Conclusion

Men with paraplegia suffer from sexual dysfunction which impacts the quality of their life and affects their partners. ED, possible absence of orgasm and infertility are conditions related to paraplegia. Patients with SCL face neurogenic ED. Erection is a neurovascular phenomenon which takes place under neuro-hormonal control. Any lesion at the involved neural pathways is responsible for this dysfunction. On the other hand the vascular element of the erection is, in general, healthy. According to these principals, the treatment strategy is designed and applied. No therapeutic method is efficient and suitable for all patients. Treatment must follow the wishes, the mental level and the skills of the patient according to the needs of the couple.

The physicians who treat paraplegic patients must take these conditions into consideration. A team work by rehabilitation doctors, urologists and psychiatrics is needed for the optimal treatment option. Sexual rehabilitation targets in neuromodulation using voluntary release of a reflex erection attempting to use this erection for sexual purpose. This is possible through stimulation of the skin or mucosa below the level of the lesion. If a trigger point which promotes an erection is identified, patient has to get familiar with the onset of this reflex in order to use it during sexual activity.

Treatment options like PDE-5 inhibitors, vacuum devices, intracavernousal injections or intra-urethral administration of vasoactive medications and penile prosthesis are in specialist's armament for the treatment of erectile dysfunction in men with paraplegia. The oral treatment with PDE-5 inhibitors is effective in the majority of paraplegic patients.

Vacuum device is a reliable treatment option with some restrictions. The most effective conservative treatment is the intracavernous injection of vasoactive drugs, as the erectile dysfunction is not caused by vascular inefficiency. Urethral application of vasoactive drugs is less effective and is associated with high incidence of hypotension. The implantation of penile prosthesis remains the most effective treatment option, which is associated with a relatively high rate of complications (~10%) in this population (Deforge et al., 2006). Sexual rehabilitation remains very important for the physical rehabilitation and the active return of these people to the society.

7. References

- Biering-Sorensen F & Sonksen J. Sexual function in spinal cord lesioned men. *Spinal Cord* 2001 Sep; 39(9):455-470
- Bird SJ & Hanno PM. Bulbocavernosus reflex studies and autonomic testing in the diagnosis of erectile dysfunction. *J Neurol Sci* 1998 Jan 21; 154(1):8-13
- Bodner DR, Haas CA, Krueger B & Seftel AD. Intraurethral alprostadil for treatment of erectile dysfunction in patients with spinal cord injury. *Urology* 1999 Jan; 53(1):199-202
- Chancellor MB, Rivas DA, Panzer DE, Freedman MK & Staas WE Jr. Prospective comparison of topical minoxidil to vacuum constriction device and intracorporeal papaverine injection in treatment of erectile dysfunction due to spinal cord injury. *Urology*. 1994 Mar; 43(3):365-9.
- Chapelle PA, Durand J & Lacert P. Penile erection following complete spinal cord injury in man. *Br J Urol* 1980 Jun; 52(3):216-219
- Courtois FJ, Macdougall JC & Sachs BD: Erectile mechanism in paraplegia. *Physiol Behav* 1993; 53:721-726
- Courtois FJ, Goulet MC, Charvier KF & Leriche A. Posttraumatic erectile potential of spinal cord injured men: how physiologic recordings supplement subjective reports *Arch Phys Med Rehabil*. 1999 Oct; 80(10):1268-1272
- Deforge D, Blackmer J, Garritty C, Yazdi F, Cronin V, Barrowman N, Fang M, Mamaladze V, Zhang L, Sampson M & Moher D. Male erectile dysfunction following spinal cord injury: a systematic review. *Spinal Cord* 2006 Aug; 44(8):465-473
- Del Popolo G, Li Marzi V, Mondaini N & Lombardi G. Time/duration effectiveness of sildenafil versus tadalafil in the treatment of erectile dysfunction in male spinal cord-injured patients. *Spinal Cord* 2004 Nov; 42(11):643-648
- Denil J, Ohl DA & Smythe C. Vacuum erection device in spinal cord injured men: patient and partner satisfaction. *Arch Phys Med Rehabil* 1996 Aug; 77(8):750-753
- Derry F, Hultling C, Seftel AD & Sipski ML. Efficacy and safety of sildenafil citrate (Viagra) in men with erectile dysfunction and spinal cord injury: a review. *Urology* 2002 Sep; 60(2 Suppl 2):49-57
- Dietzen CJ & Lloyd LK. Complications of intracavernous injections and penile prostheses in spinal cord injured men. *Arch Phys Med Rehabil* 1992 Jul; 73(7):652-655
- Eardley I & Kirby R: Neurogenic impotence. In: Kirby RS, Carson CC, Webster GD, ed. *Impotence: Diagnosis and Management of Male Erectile Dysfunction*, Oxford: Butterworth-Heinemann; 1991:227-231.

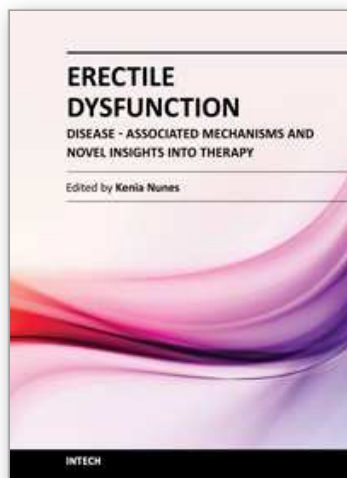
- Fisher TL, Laud PW, Byfield MG, Brown TT, Hayat MJ & Fiedler IG. Sexual health after spinal cord injury: a longitudinal study. *Arch Phys Med Rehabil* 2002 Aug; 83(8):1043-1051
- Frankel HL & Mathias CJ. Severe hypertension in patients with high spinal cord lesions undergoing electro-ejaculation--management with prostaglandin E2. *Paraplegia*. 1980 Oct; 18(5):293-299
- Giuliano F, Hultling C, El Masry WS, Smith MD, Osterloh IH, Orr M & Maytom M. Randomized trial of sildenafil for the treatment of erectile dysfunction in spinal cord injury. Sildenafil Study Group. *Ann Neurol*. 1999 Jul; 46(1):15-21
- Giuliano F, Rubio-Aurioles E, Kennelly M, Montorsi F, Kim ED, Finkbeiner AE Pommerville PJ, Colopy MW, Wilkins HJ & Wachs BH; Vardenafil Study Group. Efficacy and safety of vardenafil in men with erectile dysfunction caused by spinal cord injury. *Neurology* 2006 Jan 24; 66(2):210-216
- Giuliano F, Sanchez-Ramos A, Löchner-Ernst D, Del Popolo G, Cruz N, Leriche A, Lombardi G, Reichert S, Dahl P, Elion-Mboussa A & Casariego J. Efficacy and safety of tadalafil in men with erectile dysfunction following spinal cord injury. *Arch Neurol*. 2007 Nov;64(11):1584-92. Epub 2007 Sep 10
- Harrop JS, Sharan A & Ratliff J. Central cord injury: pathophysiology, management, and outcomes. *Spine J*. 2006 Nov-Dec; 6 (6 Suppl):S198-206
- Heller L, Keren O, Aloni R & Davidoff G. An open trial of vacuum penile tumescence: constriction therapy for neurological impotence. *Paraplegia* 1992 Aug; 30(8):550-553
- Hirsch IH, Smith RL, Chancellor MB, Bagley DH, Carsello J & Staas WE Jr. Use of intracavernous injection of prostaglandin E1 for neuropathic erectile dysfunction. *Paraplegia*. 1994 Oct;32(10):661-4.
- Kim SH. Post-traumatic erectile dysfunction: Doppler US findings. *Abdom Imaging* 2006 Sep-Oct; 31(5):598-609
- Kimoto Y & Iwatsubo E. Penile prostheses for the management of the neuropathic bladder and sexual dysfunction in spinal cord injury patients: long term follow up. *Paraplegia*. 1994 May; 32(5):336-9.
- Kimoto Y, Sakamoto S, Fujikawa K, Tachibana T, Yamamoto N & Otani T. Up-titration of vardenafil dose from 10 mg to 20 mg improved erectile function in men with spinal cord injury *Int J Urol* 2006 Nov; 13(11):1428-1433
- Lebib Ben Achour S, Laffont I, Boyer F, Boiteau F & Dizien O. Intracavernous injections in the treatment of erectile dysfunction in spinal cord injured patients: experience with 36 patients. *Ann Readapt Med Phys* 2001 Feb; 44(1):35-40
- Lombardi G, Macchiarella A, Cecconi F & Del Popolo G. Efficacy and safety of medium and long-term tadalafil use in spinal cord patients with erectile dysfunction. *J Sex Med*. 2009 Feb;6(2):535-43. Epub 2008 Dec 2
- Lombardi G, Macchiarella A, Cecconi F & Del Popolo G. Ten years of phosphodiesterase type 5 inhibitors in spinal cord injured patients. *J Sex Med*. 2009 May;6(5):1248-58. Epub 2009 Feb 9.

- Maytom MC, Derry FA, Dinsmore WW, Glass CA, Smith MD, Orr M & Osterloh IH. A two-part pilot study of sildenafil (VIAGRA) in men with erectile dysfunction caused by spinal cord injury. *Spinal Cord*. 1999 Feb; 37(2):110-116
- Mittmann N, Craven BC, Gordon M, MacMillan DH, Hassouna M, Raynard W, Kaiser A, Lanctôt LK & Tarride JE. Erectile dysfunction in spinal cord injury: a cost-utility analysis. *J Rehabil Med* 2005 Nov; 37(6):358-364
- Monga M, Bernie J & Rajasekaran M. Male infertility and erectile dysfunction in spinal cord injury: a review. *Arch Phys Med Rehabil* 1999 Oct; 80(10):1331-1339
- Padma-Nathan H, Hellstrom WJ, Kaiser FE, Labasky RF, Lue TF, Noltén WE, Norwood PC, Peterson CA, Shabsigh R, Tam PY, Place VA & Gesundheit N. Treatment of men with erectile dysfunction with transurethral alprostadil. Medicated Urethral System for Erection (MUSE) Study Group. *N Engl J Med* 1997 Jan 2; 336(1):1-7.
- Ramos AS & Samso JV. Specific aspects of erectile dysfunction in spinal cord injury. *Int J Impot Res* 2004 Oct; 16 Suppl 2:S42-45
- Rivas DA & Chancellor MB. Complications associated with the use of vacuum constriction devices for erectile dysfunction in the spinal cord injured population. *J Am Paraplegia Soc* 1994 Jul; 17(3):136-139
- Robinson LQ, Woodcock JP & Stephenson TP. Results of investigation of impotence in patients with overt or probable neuropathy. *Br J Urol* 1987, 60:583-587
- Rossier AB, Ziegler WH, Duchosal PW & Meylan J. Sexual function and Dysreflexia. *Paraplegia* 1971 May;9(1):51-63
- Saenz de Tejada I, Angulo J, Celtek S, Gonzalez-Cadavid N, Heaton J, Pickard R & Simonsen U. Pathophysiology of erectile dysfunction. *J Sex Med* 2005 Jan; 2(1):26-39
- Sánchez Ramos A, Vidal J, Jáuregui ML, Barrera M, Recio C, Giner M, Toribio L, Salvador S, Sanmartín A, de la Fuente M, Santos JF, de Juan FJ, Moraleda S, Méndez JL, Ramírez L & Casado RM. Efficacy, safety and predictive factors of therapeutic success with sildenafil for erectile dysfunction in patients with different spinal cord injuries. *Spinal Cord*. 2001 Dec; 39(12):637-43
- Smith EM & Bodner DR. Sexual dysfunction after spinal cord injury. *Urol Clin North Am* 1993 Aug; 20(3):535-542
- Soler JM, Previnaire JG, Denys P & Chartier-Kastler E. Phosphodiesterase inhibitors in the treatment of erectile dysfunction in spinal cord-injured men. *Spinal Cord*. 2007 Feb; 45(2):169-173
- Suh DD, Yang CC & Clowers DE. Nocturnal penile tumescence and effects of complete spinal cord injury: possible physiologic mechanisms. *Urology* 2003 Jan; 61(1):184-189
- Tay HP, Juma S & Joseph AC. Psychogenic impotence in spinal cord injury patients. *Arch Phys Med Rehabil* 1996 Apr; 77(4):391-393
- Vodusek DB. Bulbocavernous reflex revisited. *Neurourol Urodyn* 2003; 22(7): 681-682
- Xuan XJ, Wang DH, Sun P & Mei H. Outcome of implanting penile prosthesis for treating erectile dysfunction: experience with 42 cases. *Asian J Androl*. 2007 Sep; 9(5):716-9.
- Zasler ND & Katz PG. Synergist erection system in the management of impotence secondary to spinal cord injury. *Arch Phys Med Rehabil* 1989 Sep; 70(9):712-716

Zermann DH, Kutzenberger J, Sauerwein D, Schubert J & Loeffler U. Penile prosthetic surgery in neurologically impaired patients: long-term follow up. J Urol 2006 Mar; 175(3 Pt 1):1041-1044; discussion 1044

IntechOpen

IntechOpen



Erectile Dysfunction - Disease-Associated Mechanisms and Novel Insights into Therapy

Edited by Dr. Kenia Nunes

ISBN 978-953-51-0199-4

Hard cover, 214 pages

Publisher InTech

Published online 29, February, 2012

Published in print edition February, 2012

Erectile dysfunction is a widespread problem, affecting many men across all age groups and it is more than a serious quality of life problem for sexually active men. This book contains chapters written by widely acknowledged experts, each of which provides a unique synthesis of information on emergent aspects of ED. All chapters take into account not only the new perspectives on ED but also recent extensions of basic knowledge that presage directions for further research. The approach in this book has been to not only describe recent popular aspects of ED, such as basic mechanism updates, etiologic factors and pharmacotherapy, but also disease-associated ED and some future perspectives in this field.

How to reference

In order to correctly reference this scholarly work, feel free to copy and paste the following:

Charalampos Konstantinidis (2012). Erectile Dysfunction in Paraplegic Males, *Erectile Dysfunction - Disease-Associated Mechanisms and Novel Insights into Therapy*, Dr. Kenia Nunes (Ed.), ISBN: 978-953-51-0199-4, InTech, Available from: <http://www.intechopen.com/books/erectile-dysfunction-disease-associated-mechanisms-and-novel-insights-into-therapy/erectile-dysfunction-in-paraplegic-males>

INTECH
open science | open minds

InTech Europe

University Campus STeP Ri
Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447
Fax: +385 (51) 686 166
www.intechopen.com

InTech China

Unit 405, Office Block, Hotel Equatorial Shanghai
No.65, Yan An Road (West), Shanghai, 200040, China
中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
Phone: +86-21-62489820
Fax: +86-21-62489821

© 2012 The Author(s). Licensee IntechOpen. This is an open access article distributed under the terms of the [Creative Commons Attribution 3.0 License](https://creativecommons.org/licenses/by/3.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

IntechOpen

IntechOpen