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REVIEW

Penile vibratory stimulation and electroejaculation in the treatment of ejaculatory dysfunction[1]

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Summary

The purpose of this review is to present the current understanding of penile vibratory stimulation (PVS) and electroejaculation (EEJ) procedures and its clinical use in men with ejaculatory dysfunction. Unfortunately, the record of treating such individuals has been quite poor, but within recent years development and refinement of PVS and EEJ in men with spinal cord injury (SCI) has significantly enhanced the prospects for treatment of ejaculatory dysfunction. The majority of spinal cord injured men are not able to produce antegrade ejaculation by masturbation or sexual stimulation. However, approximately 80% of all spinal cord injured men with an intact ejaculatory reflex arc (above T10) can obtain antegrade ejaculation with PVS. Electroejaculation may be successful in obtaining ejaculate from men with all types of SCI, including men who do not have major components of the ejaculatory reflex arc. Because vibratory stimulation is very simple in use, non-invasive, it does not require anaesthesia and is preferred by the patients when compared with EEJ, PVS is recommended to be the first choice of treatment in spinal cord injured men. Furthermore, EEJ has been successfully used to induce ejaculation in men with multiple sclerosis and diabetic neuropathy. Any other conditions which affect the ejaculatory mechanism of the central and/or peripheral nervous system including surgical nerve injury may be treated successfully with EEJ. Finally, for sperm retrieval and sperm cryopreservation before intensive anticancer therapy in pubertal boys, PVS and EEJ have been successfully performed in patients who failed to obtain ejaculation by masturbation. Nearly all data concerning semen characteristics in men with ejaculatory dysfuntion originate from spinal cord injured men. Semen analyses demonstrate low sperm motility rates in the majority of spinal cord injured men. The data give evidence of a decline in spermatogenesis and motility of ejaculated spermatozoa shortly after (few weeks) an acute SCI. Furthermore, it is suggested that some factors in the seminal plasma and/or disordered storage of spermatozoa in the seminal vesicles are mainly responsible for the impaired semen profiles in men with chronic SCI. Home insemination with semen obtained by penile vibratory and introduced intravaginally in order to achieve successful pregnancies may be an option for some spinal cord injured men and their partners. The majority of men will further enhance their fertility potential when using either penile vibratory or EEJ

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combined with assisted reproduction techniques such as intrauterine insemination or in-vitro fertilization with or without intracytoplasmic sperm injection.

Keywords: ejaculatory dysfunction, electroejaculation, semen, spinal cord injuries, vibration

Introduction

Ejaculatory dysfunction is an uncommon cause of male infertility in the general population (Dubin & Amelar, 1971). However, ejaculatory dysfunction is the major cause of infertility in certain clinical situations such as in men with spinal cord injury (SCI), multiple sclerosis, diabetic neuropathy, idiopathic anejaculation or iatrogenic neurological lesions. Historically, the record of treating such individuals has been quite poor.

More recently, in SCI men, the development and refinement of penile vibratory stimulation (PVS) (Sønksen *et al.*, 1994) and electroejaculation (EEJ) (Halstead *et al.*, 1987) has generally enhanced the prospects for treatment of ejaculatory dysfunction.

This review will focus on the current understanding of EEJ and PVS procedures and its clinical use. A presentation of the clinical results obtained following PVS or EEJ in the SCI population including semen characteristics and pregnancy rates will be given.

Physiology of ejaculation

The ejaculatory reflex represents a complex set of events culminating in projectile expulsion of semen from the urethra. There are several neurophysiologic components of this spinal reflex as shown in Fig. 1 (Thomas, 1983). The brain, spinal cord, sympathetic and parasympathetic elements of the autonomic nervous system, and motor (efferent) and sensory (afferent) elements of the peripheral nerves all participate in the initiation, elaboration and coordination of ejaculation (Siroky, 1988; Hendry *et al.*, 2000; Lundberg *et al.*, 2000). The activities of the sympathetic and parasympathetic innervation of ejaculation are complementary, rather than antagonistic.

The ejaculatory reflex is usually initiated by a combination of cerebral and genital input and is coordinated in the thoracolumbar area of the spinal cord. The reflex has afferent input from genital tactile sensation via the dorsal nerves of the penis and also from erotic stimuli from cerebrocortical centres. Efferent outflow for the reflex is via sympathetic

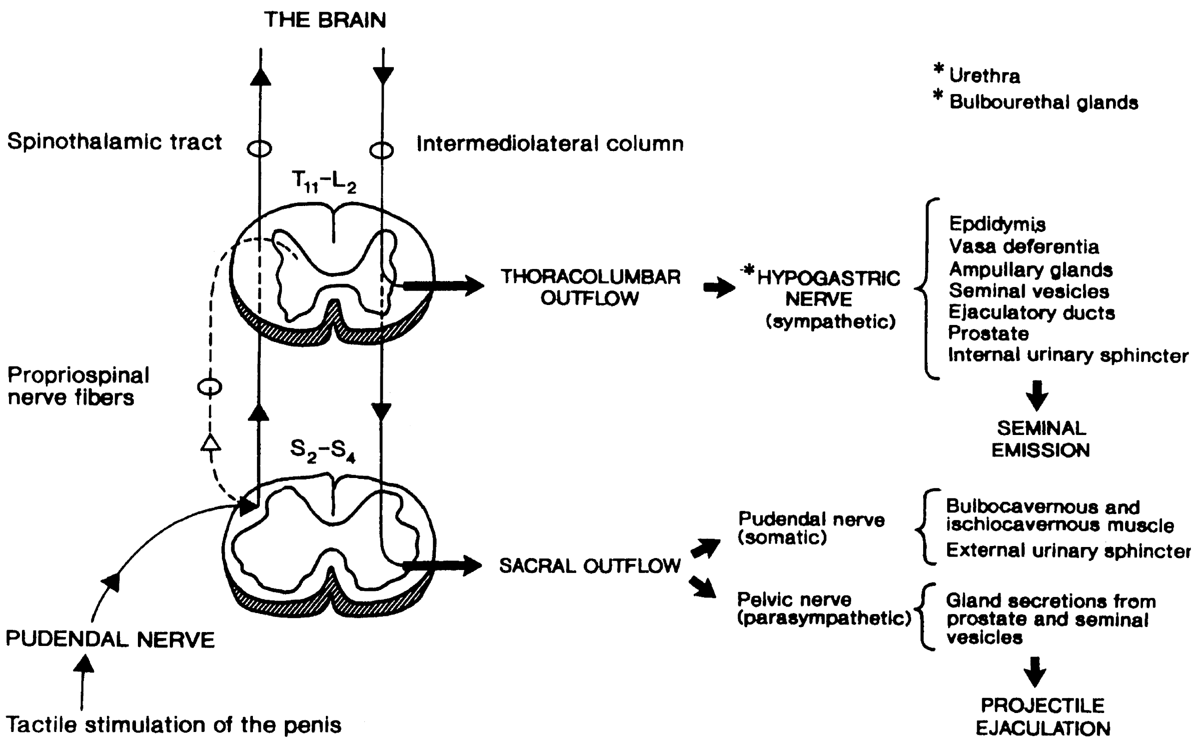

Figure 1. The spinal cord and the efferent and afferent nerve fibres involved in the ejaculation. The urethra and bulbourethral glands are also innervated by the hypogastric nerve but are not a part of the seminal emission.

fibres arising from the thoracolumbar spinal cord (T11-L2), and thus, seminal emission and internal bladder neck closure are controlled mainly by the sympathetic nervous system. Parasympathetic efferent innervation arising from the sacral spinal cord (S2-S4) also appears to be involved in emission by contributing to the formation of seminal fluid. Projectile ejaculation is controlled by somatic nerve fibres (S2-S4).

Even when the spinal cord is disconnected from the brain as in men with complete SCI, the neurological components of the ejaculatory centre in the spinal cord may respond to PVS and produce reflex ejaculation (Sønksen *et al.*, 1994).

Assisted ejaculation procedures

Electroejaculation

Rectal EEJ has been one of the most frequently used treatments for ejaculatory dysfunction in men with SCI for many years. EEJ was first described in humans by Learmonth (1931). Horne *et al.* (1948) reported the first use of EEJ in SCI persons, resulting in successful ejaculation in nine of 15 men. In the 1980s, Seager further refined the method of EEJ and developed several prototypes of equipment (Halstead *et al.*, 1987) (Fig. 2).

Electroejaculation is carried out with an electrical probe, which is inserted rectally and is positioned with the electrodes in contact with the anterior rectal wall in the area of the prostate gland and the seminal vesicles (Fig. 3). The electrical stimulation is administered in a wave-like pattern with voltage progressively increasing in 1–2 V increments until ejaculation occurs (Halstead *et al.*, 1987; Ohl & Sønksen, 1996). It is usually recommended that a low level of electrical baseline (100 mA) be maintained between voltage peaks and during ejaculation. However, in a recent study concerning sphincteric events during EEJ and PVS in men with SCI, it was suggested that it would be optimal in EEJ procedures to discontinue electrical stimulation completely during ejaculation to allow greater relaxation of the external urethral sphincter, which may increase the percentage of semen ejaculated in the antegrade direction (Ohl *et al.*, 2000; Sønksen *et al.*, 2001; Brackett *et al.*, 2002).

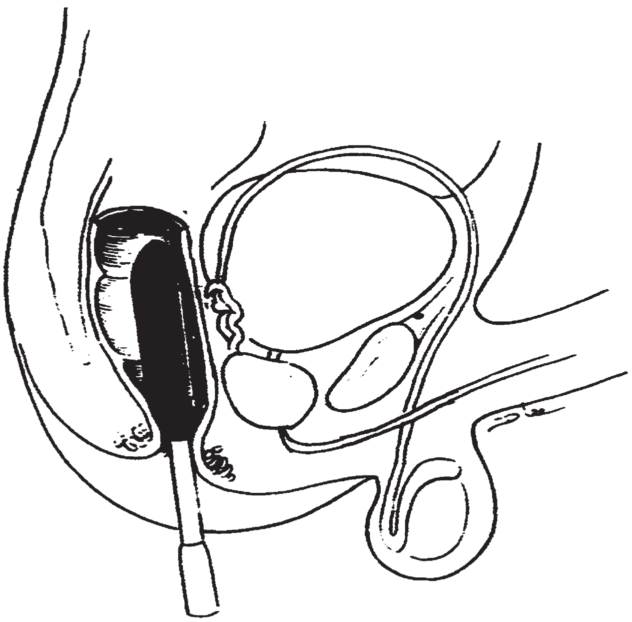

Figure 3. Rectal probe position during electroejaculation procedure.

Figure 2. Seager Model 11 Electroejaculator and rectal probe (Dalzall USA Medical Systems, The Plains, VA, USA). The rectal probes used during the electroejaculation procedure are generally 3 cm in diameter with either a transverse or a longitudinal arrangement of the electrodes. Alternating current (0–50 V/0–1000 mA) is used to perform the electrical stimulation.

Antegrade ejaculate is not produced in a projectile fashion, but rather as an intermittent release of semen during the course of the procedure (Brindley, 1981a; Halstead *et al.*, 1987). Between 15 and 35 stimulations are usually needed to ensure emptying of the semen (Halstead *et al.*, 1987). The voltage and current that have been reported to successfully produce ejaculation range from 5 to 25 V and 100–600 mA, respectively (Ohl *et al.*, 1989a).

Prior to the EEJ procedure, the patient's bladder is catheterized to completely empty it of urine, because many individuals have a substantial portion of retrograde ejaculation (Ohl *et al.*, 1989a). Because urine may adversely affect this retrograde ejaculate, a buffering medium (e.g. Ham's F 10 medium) can be instilled into the bladder before the EEJ (Crich & Jequier, 1978; Ohl & Sønksen, 1997). After the procedure, the bladder is catheterized again to empty the retrograde fraction. Rectoscopy is performed prior to the procedure to confirm that there are no pre-existing rectal lesions and after the procedure to exclude injury to the rectum.

It should be noted that EEJ can cause significant discomfort in men with partly preserved sensation, and they may require either a spinal or general anaesthesia before treatment (Brindley, 1981a; Perkash *et al.*, 1985; Sarkarati *et al.*, 1987; Ohl & Sønksen, 1997). In addition, EEJ may produce autonomic dysreflexia in men with SCI above T6 (Frankel & Mathias, 1980). Blood pressure monitoring should be performed throughout the procedure; men who are susceptible to autonomic dysreflexia or who have experienced episodes with prior trials of EEJ may be pre-medicated with nifedipine (Steinberger *et al.*, 1990).

Penile vibratory stimulation

The PVS to induce ejaculation was first described by Sobrero *et al.* (1965) in a group of men without SCI. The first reported use of PVS in a man with SCI was with a hand massager (Comarr, 1970). A number of investigators have reported successful results in achieving ejaculations with PVS, but Brindley (1981b) has been credited with refining the technique most frequently used with PVS in men with SCI. In his initial studies, Brindley (1981b, 1984) reported successful ejaculation in 48 of 81 men with SCI.

The PVS procedure is performed with the individual in the supine position or in a sitting position (Sønksen *et al.*, 1994). The goal of PVS is to activate the ejaculatory reflex in the thoracolumbar area of the spinal cord. The afferent penile dorsal nerve stimulation is provided by application of a vibrating disc against the frenulum for periods of 2½–3 min or until antegrade ejaculation occurs (Fig. 4). If no ejaculation occurs the stimulation period is followed by a rest period of 1–2 min and stimulation begins again. An antegrade ejaculation occurs as a pulsatile projectile ejaculation similar to normal ejaculation. In contrast to EEJ, nearly all spermatozoa in PVS trials are ejaculated in the antegrade direction in SCI men (Ohl *et al.*, 1997). The required time to induce ejaculation by PVS in SCI men ranges from 10 sec to 45 min (Brindley, 1981b; Beretta *et al.*, 1989; Szasz & Carpenter, 1989). During PVS, somatic reactions such as erections, abdominal muscle contractions and leg spasms may be seen (Szasz & Carpenter, 1989).

In contrast to EEJ, PVS requires an intact spinal cord at the level of T11-S4 in order to induce antegrade ejaculation (Brindley, 1981b, 1984; Szasz & Carpenter, 1989). However, the data from Brindley's (1984) study concerning the exact level and completeness of spinal cord lesion in relation to the ejaculatory response is unclear. Szasz & Carpenter (1989) reported from their work that the level and completeness of the spinal cord lesion could not predict with certainty successful ejaculation by PVS in a group of 35 men with SCI.

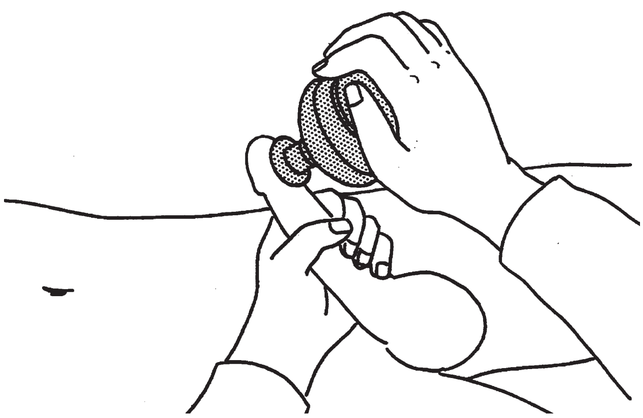

Figure 4. Vibrator disc position during penile vibratory stimulation.

Furthermore, Brindley (1984) noted that the most important factor indicating whether or not an ejaculate could be obtained by PVS was the clinical presence or absence of the hip flexion reflex (L2-S1), which is elicited by scratching the soles of the feet. Ejaculation was obtained in 75% of men with SCI who had an intact hip flexion reflex and in no men who did not have the hip flexion reflex. However, it should be noted that 25% of men with SCI who had the clinical presence of hip flexion reflex failed to ejaculate by PVS. Szasz & Carpenter (1989) noted that the absence of bulbocavernous reflex (S2-S4) predicted no ejaculatory response by PVS in most men with SCI.

Although there are no clearly defined or standardized parameters for the application of PVS in men with SCI, it has been suggested that the output of the vibrators and, in particular, the amplitude might have some effect on the ejaculatory response (Brindley, 1984; Szasz & Carpenter, 1989). In fact, a wide range of ejaculation rates (19–91%) has been reported in the literature and may be the result of the fact that several non-medical vibrators have been used and the output from these vibrators may vary widely and are not standardized (Piera, 1973; Brindley, 1981b, 1984; Sarkarati *et al.*, 1987; Beilby & Keogh, 1989; Beretta *et al.*, 1989; Szasz & Carpenter, 1989; Siösteen *et al.*, 1990; Rawicki & Hill, 1991).

Sønksen *et al.* (1994) examined the ejaculatory response in men with SCI to varying amplitudes of PVS and found that the highest rates of ejaculation (antegrade plus retrograde) were seen with a vibrator amplitude level of 2.5 mm and a frequency of 100 Hz (96%), and low rates were seen when the amplitude was only 1 mm (32%) also at a frequency of 100 Hz. The effectiveness of the high amplitude vibration by obtaining an ejaculation rate of 83% in another comparable group of 41 SCI men with ejaculatory dysfunction was also noted. Based on these results a medical grade vibrator for SCI men has been developed (Fig. 5).

In the same study (Sønksen *et al.*, 1994), antegrade ejaculation was seen only in men with cord lesions above T10, and no other absolute predictors of the ejaculatory response were identified among patient characteristics related to reflexes, completeness of lesions, somatic reactions, age and time since SCI. However, when the reflexes and/or somatic reactions such as erections, abdominal muscle contractions, and leg spasms were present during PVS, there was a significantly higher percentage of men with antegrade ejaculation compared with those men in whom none of the reflexes and/or somatic reactions were seen.

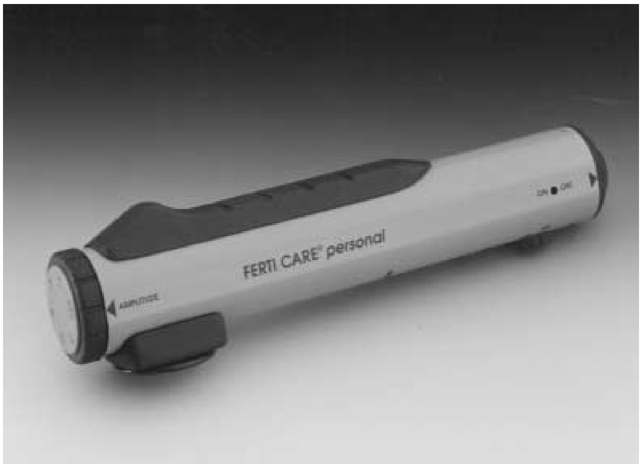

Figure 5. FERTI CARE®*personal* (Multicept A/S, Hørsholm, Denmark) vibrator developed to induce ejaculation in men with spinal cord injuries in the home environment. The amplitude and frequency may be set at the recommended 2.5 mm and 100 Hz, or according to individual requirements. The options available include amplitudes between 1.0 and 3.5 mm and frequencies between 70 and 110 Hz. The vibrator has an overload indicator to avoid application of excessive pressure (to prevent skin injuries) and simultaneously indicate the recommended pressure.

In general, PVS is a well-tolerated procedure with very few potential complications. Local skin abrasion may occur on occasions where the vibrator is applied, but no special treatment is usually required other than relief from further irritation. In men with neurologic levels at or above T6, the application of PVS may induce autonomic dysreflexia, if they are prone to this condition (Frankel & Mathias, 1980; Comarr, 1985). As in EEJ treatment, the individual may be pre-medicated with nifedipine prior to the procedure to minimize the blood pressure elevation and symptoms. Blood pressure monitoring should be performed during the procedure, especially in men prone to or with a history of autonomic dysreflexia.

Clinical use

Electroejaculation

Men with SCI commonly suffer from ejaculatory dysfunction. In a review of the literature examining papers written on widely differing patient groups, the incidence of any retained ejaculatory function among SCI men was between 0 and 55% with most studies showing numbers which approach 0% (Sønksen & Biering-Sørensen, 1992).

EEJ may be successful in obtaining ejaculate from men with all types of SCI, including men who are missing major components of the ejaculatory reflex arc (Ohl & Sønksen, 1997). In a prospective study by Ohl *et al.* (1989a) predictors of success in relation to the response of 48 men with SCI to EEJ were studied. In relation to successful EEJ, they found no significant difference between men with SCI with high vs. low or complete vs. incomplete spinal cord lesions. Ejaculation was produced in 60% of cervical patients compared with 50% of lumbar patients. Ejaculation was seen in 71% of men with complete lesions and in 61% with incomplete lesions. However, more recent studies show that it is possible to induce ejaculation with EEJ in 80–100% of all men with SCI (Lucas *et al.*, 1991; Matthews *et al.*, 1996; Nehra *et al.*, 1996; Ohl *et al.*, 1996; Ohl & Sønksen, 1997).

Multiple sclerosis can also affect ejaculatory function through either a central or peripheral nerve disturbance. Electroejaculation has been successfully used to induce ejaculation and achieve pregnancy (Ohl *et al.*, 1989b).

Patients with diabetic neuropathy occasionally suffer from peripheral neuropathy which may lead to ejaculatory dysfunction. Many diabetic men with ejaculatory dysfunction experience a relatively slow progression of their problem, with an initial phase of decreased ejaculate volume followed by retrograde ejaculation and then total absence of ejaculation. Some subjects can be treated with sympathomimetic agents in the initial phase of the dysfunction, but, once well established, total absence of ejaculation will require EEJ, which has been demonstrated to be successful in both sperm retrieval and in establishing pregnancies in this subpopulation (Gerig *et al.*, 1997).

Any other conditions which affect the ejaculatory mechanism of the central and/or peripheral nervous system including surgical nerve injury may be treated successfully with EEJ.

In a recent study examining sperm retrieval and sperm cryopreservation before intensive anticancer therapy in pubertal boys, EEJ was successfully performed in two persons who failed to obtain ejaculation by masturbation (Müller *et al.*, 2000).

Penile vibratory stimulation

Approximately 80% of all SCI men with an intact ejaculatory reflex arc (above T10) can be managed with PVS to induce reflex ejaculation when using correct vibration output (amplitude 2.5 mm and frequency of 100 Hz) (Sønksen *et al.*, 1994). Furthermore, PVS is very simple in use, non-invasive, does not require anaesthesia and is preferred by the patients when compared with EEJ (Ohl *et al.*, 1997). Consequently, PVS is recommended to be the first choice of treatment in SCI men with ejaculatory dysfunction with EEJ reserved for PVS failures.

Like EEJ, PVS has also been used successfully to induce ejaculation in pubertal boys who failed to obtain ejaculation by masturbation in order to cryopreserve sperm before anticancer therapy (Müller *et al.*, 2000).

Semen characteristics

In men with ejaculatory dysfunction nearly all data on semen characteristics originate from SCI men following PVS or EEJ. The semen is, in general, characterized by normal to high sperm count and low sperm motility rates compared with WHO standards (Brindley, 1984; Beretta *et al.*, 1989; Ohl *et al.,* 1989a; Siösteen *et al.*, 1990; WHO, 1992; Brackett *et al.*, 1995; Rutkowski *et al.*, 1995; Nehra *et al.*, 1996; Sønksen *et al.*, 1996; Ohl *et al.*, 1997).

Several theories have been suggested to explain the impaired sperm motility in men with chronic SCI such as urinary tract infections, type of urinary bladder management, abnormal testicular histology, testicular hyperthermia, changes in the sex hormonal profiles, antisperm antibodies and sperm stagnation in the seminal ducts because of anejaculation (Linsenmeyer & Perkash, 1991). In the literature (Linsenmeyer & Perkash, 1991; Biering-Sørensen & Sønksen, 2001) no final answers concerning these factors can be found, however, none of them are the sole cause of the impairment of sperm motility in SCI men.

Recent investigations indicate that factors in the seminal plasma contribute to the impaired sperm motility in SCI men. For example, seminal plasma from ejaculates of SCI men inhibited motility of sperm from normal men, and seminal plasma from normal men improved motility of sperm from SCI men (Brackett *et al.*, 1996). Furthermore, it has been demonstrated that the viability and motility rate of ejaculated spermatozoa induced by PVS or EEJ was significantly lower than the viability and motility rate of spermatozoa aspirated from the vas deferens in a group of 12 SCI men compared with non-SCI controls (Brackett *et al.*, 2000). This indicates that an accessory gland factor is responsible for the low sperm motility.

Another recent study (Ohl *et al.*, 1999) found that large numbers of senescent spermatozoa with poor motility and viability are present within the seminal vesicles of SCI men and these spermatozoa comprise a large portion of the ejaculates obtained by PVS and EEJ. This indicates that SCI men have disordered storage of spermatozoa in the seminal vesicles leading to impaired quality of ejaculated semen.

Differences in semen profiles from the use of EEJ and PVS in SCI men and, in particular, the potential damaging effects of EEJ on semen profiles have been discussed in the literature (Brindley, 1984; Linsenmeyer & Perkash, 1991). In a prospective study (Ohl *et al.*, 1997) of 11 SCI men it was shown that the motility rate of PVS induced antegrade sperm was significantly better than that of EEJ induced antegrade sperm, although such motility rates are subnormal with both methods. This difference in sperm motility rates may be the result of the effect of chronic denervation caused by SCI rather than the method of assisted ejaculation. However, a similar significant difference between PVS and EEJ has been shown in the antegrade sperm motility rates in a non-human spinal cord intact primate model (Yeoman *et al.*, 1998). This indicates that the EEJ method itself may compromise the sperm motility rate in antegrade ejaculates and should be taken into consideration when fertility and semen characteristics are studied in SCI men.

In another PVS study including 51 SCI men (Sønksen *et al.*, 1996) it was demonstrated that the completeness and level of lesion also influence the sperm motility with significantly higher motility rates in men with cervical vs. thoracic lesions, lesions at or above T6 vs. below T6 and incomplete vs. complete lesions, respectively. This is in contrast to the EEJ study by Ohl *et al.* (1989a) where the sperm motility was highest in the thoracic lesions and the presence of motile sperm was more frequent with complete lesions.

The acute effects of SCI on semen characteristics in humans have only been addressed in one study (Mallidis *et al.*, 1994). The paucity of information is no doubt the result of the fact that men with acute SCI are not physiologically or emotionally prepared to participate in assisted ejaculation studies and their recovery may demand attention in so many other areas of acute treatment and rehabilitation as well as social reintegration. However, in the study by Mallidis *et al.* (1994), EEJ was used to obtain frequent ejaculates in seven men from day 2 after an acute SCI. No decline in semen profiles was seen until day 16. Thereafter sperm motility and viability decreased towards the pattern seen in chronic SCI men.

Very few other studies have examined the direct changes in spermatogenesis and semen characteristics during the acute phase of neurological injury. Billups *et al.* (1990a,b) demonstrated in a sympathectomized rat model decreased epididymal sperm motility as well as disordered epididymal spermatozoa storage. Huang *et al.* (1998) performed SCI in a rat model to examine acute changes in spermatogenesis. Different groups of rats were sacrificed at various time points after SCI. They found that significant decreases in spermatogenesis were seen few days after SCI with some recovery noted after 6 months. While useful information was gained by these studies (Billups *et al.*, 1990a,b; Huang *et al.*, 1998), what was still lacking in these models was the ability to examine serial changes in spermatogenesis in the same animals, and the ability to examine ejaculated semen characteristics, rather than epididymal spermatozoa. To investigate these questions, a dog model of SCI has been developed allowing serial examination of both semen profiles and spermatogenesis in the same animals. The data from this model give strong evidence for a decline in spermatogenesis and sperm motility at 3 weeks following SCI compared with non-SCI control dogs (Ohl *et al.*, 2001).

The mechanisms responsible for the impaired semen characteristics in SCI men is still largely unknown but to gain more insight into the impact of the autonomic nervous system on the production, transport and storage of spermatozoa as well as the composition of biochemical substances in the seminal fluid further studies are required. Also studies of changes in spermatogenesis and semen characteristics from the acute SCI, through spinal shock, and into the chronic phase of SCI remain to be performed.

Pregnancy rates

Penile vibratory stimulation and vaginal self-insemination performed by the couple at home is a viable option for those SCI men with adequate semen parameters (Brindley, 1984; Dahlberg *et al.*, 1995; Nehra *et al.*, 1996; Löchner-Ernst *et al.*, 1997; Sønksen *et al.*, 1997). A non-spermicidal container is used for collection of the ejaculate and a 10-mL syringe is used for ovulation timed vaginal self-insemination.

Brindley (1984) reported seven home pregnancies following PVS and vaginal self-insemination with delivery of five healthy babies (one ongoing/one spontaneous abortion). Recently, several pregnancies have been reported from PVS procedures combined with self-insemination at home (Dahlberg *et al.*, 1995; Nehra *et al.*, 1996; Löchner-Ernst *et al.*, 1997; Sønksen *et al.*, 1997). Most studies reported that multiple ovulation cycles were used to achieve home pregnancies and the overall pregnancy rate per couple range from 25 to 61%.

The unique advantage of PVS is the possibility of home use. It will also allow the majority of SCI couples to perform the PVS procedure themselves at the hospital when a specimen is required in connection with assisted reproduction techniques.

Furthermore, several successful pregnancies have been reported (Dahlberg *et al.*, 1995; Ohl *et al.*, 1995; Nehra *et al.*, 1996; Löchner-Ernst *et al.*, 1997; Brinsden *et al.*, 1997; Hultling *et al.*, 1997; Sønksen *et al.*, 1997) using spermatozoa obtained by PVS or EEJ combined with assisted reproduction techniques such as intrauterine insemination or in-vitro fertilization with or without intracytoplasmic sperm injection. The overall pregnancy rate per cycle from those studies (Dahlberg *et al.*, 1995; Ohl *et al.*, 1995; Nehra *et al.*, 1996; Löchner-Ernst *et al.*, 1997; Hultling *et al.*, 1997; Brinsden *et al.*, 1997; Sønksen *et al.*, 1997) averages about 25%. It should be noted that this rate is similar to the pregnancy rate per cycle during natural procreation in healthy couples wanting to become pregnant (25–30%) (Spira, 1986), although assisted ejaculation procedures and reproduction techniques are required for SCI men and their partners.

If assisted ejaculation procedures fail or yield insufficient motile and/or viable spermatozoa for assisted reproductive techniques, surgical procedures of sperm retrieval are indicated. There have been several case reports of pregnancies obtained with sperm from surgical retrieval in SCI men (Dahlberg *et al.*, 1995; Watkins *et al.*, 1996; Marina *et al.*, 1999).

When sperm is surgically retrieved from this patient population, the couples are generally required to use in-vitro fertilization with intracytoplasmic sperm injection. It is a fact that high-level assisted reproductive techniques are necessary to achieve pregnancy which makes surgical sperm retrieval less appealing to the authors. Many couples will become pregnant with home insemination or hospital-based insemination, obviating the need for in-vitro fertilization. If one espouses the procedure of direct sperm retrieval, the couple is usually committed to an invasive, expensive procedure to become pregnant.

In conclusion, several fertility treatment options are available to enhance the reproduction prospects in SCI men and their partners. The proper choice of treatment should be made through coordinated efforts of different specialities, which may involve urology, gynaecology, andrology and rehabilitation.

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