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TOPIC PAPER

Fertility and sexuality in the spinal cord injury patient

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Abstract

Background After a spinal cord injury, patients have different perceptions of sexuality, sexual function, and potential for fertility. These changes can greatly impact quality of life over a lifetime.

Purpose The purpose of this workgroup was to identify common evidence based or expert opinion themes and recommendations regarding treatment of sexuality, sexual function and fertility in the spinal cord injury population.

Methods As part of the SIU-ICUD joint consultation of Urologic Management of the Spinal Cord Injury (SCI), a workgroup and comprehensive literature search of English language manuscripts regarding fertility and sexuality in the spinal cord injury patient were formed. Articles were compiled, and recommendations in the chapter are based on group discussion and follow the Oxford Centre for Evidence-based Medicine system for levels of evidence (LOEs) and grades of recommendation (GORs).

Results Genital arousal, ejaculation, and orgasm are significantly impacted after spinal cord injury in both male and female SCI patients. This may have a more significant impact on potential for fertility in male spinal cord injury patients, particularly regarding ability of generate erection, semen quantity and quality. Female patients should be consulted that pregnancy is still possible after injury and a woman should expect resumption of normal reproductive function. As a result, sexual health teaching should be continued in women despite injury. Pregnancy in a SCI may cause complications such as autonomic dysreflexia, so this group should be carefully followed during pregnancy.

Conclusions By understanding physiologic changes after injury, patients and care teams can work together to achieve goals and maximize sexual quality of life after the injury.

Keywords Spinal cord injury · Sexuality · Fertility · Pregnancy

Introduction

A spinal cord injury (SCI) impacts fertility and sexuality in both men and women. In addition to managing the urinary symptoms, the urologist plays a key role in the education and management of these important quality of life issues in this population. Although there is overlap in treatment strategies with the general population, fertility and sexuality in spinal cord injury requires understanding of options, outcomes, and potential complications which can be unique to the injured. In this manuscript, we review alternations in sexual physiology after spinal cord, sexual therapy/treatment options to restore sexuality, and female and male fertility potential.

Methods

This work represents the efforts of SIU-ICUD joint consultation on Urologic Management of the Spinal Cord injury. For this specific topic, a workgroup was formed and comprehensive literature search of English language manuscripts regarding fertility and sexuality in the spinal cord injury patient. Articles were compiled, and recommendations in the chapter are based on group discussion and follow the Oxford Centre for Evidence-based Medicine system for levels of evidence (LOEs) and grades of recommendation (GORs).

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Alterations in sexual physiology after spinal cord injury

Sexual function measures for SCI populations

The Female Sexual Function Index (FSFI), measurement of vaginal pulse amplitude (VPA), the International Index of Erectile Function (IIEF), and the measurement of ejaculatory function and semen quality were considered appropriate measures to assess sexual responses and reproductive function after SCI. For clinical trials aiming to improve sexual function after SCI, the FSFI or the IIEF is currently preferred. Although VPA is an appropriate means to assess female sexual responses, it is only useful for laboratory studies and is too invasive for use in clinical trials. For assessment of male fertility potential, assessment of ejaculatory capacity and semen analysis are recommended [1].

Regarding future direction of sexual function measures, there are new data sets for documenting residual function after SCI including the inter-rater validated International Standards to Document Remaining Autonomic Function after Spinal Cord Injury [2] that will be used for research purposes in the future.

Genital arousal

Without the use of medications or assisted devices, the natural erectile ability of men with SCI, from either psychogenic or reflexogenic sources, will depend on the level and completeness of the lesion. Although erectile ability has been reported to be 62–75%, about two-thirds of men with SCI find their erections to be unreliable or be short in duration, necessitating the use of some form of erection enhancement in 60% of them [3].

The vast majority of men and women with SCI find it difficult to become physically aroused, and more women (74.7%) than men (48.7%) have difficulty becoming psychologically aroused [4, 5]. Tingling sensations (35.3%) and spasms (35%) were the most reported physical sensations noted by men and women with SCI [5]. Of the women with SCI ($n = 87$), 58.6% could feel the buildup of sexual tension in their body during sexual stimulation (this was positively correlated with the presence of genital sensation), and 64.4% stated that they could feel this buildup in their head [4]. Of the men ($n = 199$), roughly half reported no difficulty becoming mentally arousal (48.7%), but difficulty becoming physically aroused was reported by the vast majority (84.9%). Only about half the men could feel a buildup of both psychological and physical sexual tension, and 61.8% were able to achieve erection without medication or assistance (albeit not reliable and of short duration) [3].

Ejaculation

While ejaculation potential depends, like erection, on the level and completeness of the lesion, ejaculation is more likely in men who have preserved bladder and bowel control, spasticity, the ability to achieve a psychogenic erection, the ability to retain an erection, and direct penile manipulation versus vaginal intercourse [6]. Ejaculation is more predictable when there is a significant increase in blood pressure with sexual stimulation. With unassisted masturbation alone, only about 10–15% of men with SCI can ejaculate. With the use of penile vibrostimulation (PVS), this number increases, especially if the injury is at or rostral to T10 [7]. Having an intact dorsal penile nerve when the injury is rostral to T10 (indicating an intact ejaculatory reflex) is predictive of ejaculatory capacity to vibrostimulation, as is the level of the lesion (ejaculatory capacity is 86% when the injury is T10 or rostral, and is 15% when the injury is T11 or caudal) [6, 7].

Orgasm

Orgasm is the release of vasocongestion and neuromuscular tension or the peak of sexual excitement. It is usually accompanied by pleasant genital and physical sensations, and is associated with mental euphoria. Approximately 40–50% of men and women with SCI are able to reach either self-defined or laboratory-recorded orgasmic release, although the length and intensity of stimulation required to reach orgasm may be longer than it was before injury [8]. After SCI, having a complete versus incomplete injury (regardless of level of injury), having an intact sacral reflex arc, and having genital sensation are more predictive of orgasm in both sexes [6]. Although orgasm and ejaculation are likely to occur together in men with SCI, the presence of orgasm is not necessarily connected with the presence of ejaculation [1]. Chéhensse et al. published a review of articles from 1955 to 2012 and found that ejaculation after complete SCI occurred with masturbation or coitus 11.8% of the time, with the use of PVS followed by masturbation 47.7% of the time, and with the use of acetylcholinesterase inhibitors followed by masturbation 54.7% of the time [9].

The likelihood of either reaching ejaculation or experiencing orgasm after SCI may be modestly enhanced by the utilization of oral erection medications such as a phosphodiesterase type 5 (PDE5) inhibitor, which is now commonly used in many men with SCI, either sexually or in fertility clinics. The likelihood of reaching ejaculation and/or experiencing orgasm may also be improved with the use of sympathomimetic drugs such as midodrine [10, 11].

Pleasurable or orgasmic experience at ejaculation may also be related to the phenomenon of autonomic dysreflexia (AD), which is defined as an increase in systolic blood

pressure by 20 mmHg [12]. It can render sex unenjoyable or lead to active avoidance in some SCI patients. In fact, in a recent survey, AD interfered with the motivation to be sexual in 28% of women and 16% of men [3]. However, researchers have found that if AD does not occur, few orgasmic sensations are reported and that with mild-to-moderate AD, pleasurable climactic sensations are reported. In contrast, unpleasant or painful sensations are reported with severe AD [13]. Especially for women, compounding psychological issues beyond the sensation changes (e.g., feeling unattractive or less attractive, having less self-confidence, or having fear of incontinence) may also interfere with the ability to reach orgasm [14].

There are few tools in the literature to describe and assess this sexual climax referred to as orgasm. However, Mah and Binik [15] did develop a questionnaire to assess the subjective experience of orgasm in able-bodied persons, as did Courtois and colleagues after SCI [10]. Functional MRI studies have also attempted to look at cerebral correlates of orgasm after SCI [16]. Functional MRI of the brain during orgasm in women with injury at T10 or higher using vaginal-cervical mechanical self-stimulation suggested that the vagus nerves provide a spinal cord-bypass pathway for vaginal-cervical sensibility, and activation of this pathway can produce orgasm [17].

Sexual therapy/treatment after injury

Sexual drive

Managing biological or medical factors (e.g., replacement of lowered testosterone or estrogen), treating depression (which leads to low libido and poor genital arousal), addressing the method of bladder or bowel management and of incontinence, and managing fatigue or pain can greatly improve sexual motivation and payoff. Iatrogenic medications primarily affect sexual drive, as well as affect sexual function, and secondarily affect sexual interest. Psychological and relationship issues affecting sexual motivation also need to be addressed by the appropriate resources. Testosterone replacement to the eugonadal range can be considered in hypogonadal men with SCI [18], and has been used in postmenopausal women without SCI with some precautions. Testosterone can also potentially improve lean body mass and reduce fat tissue mass, which can affect sexual self-image, particularly in men. Proper dosing and monitoring are required. Since an association between low vitamin D and hypogonadism exists in men with SCI [19] and is associated with erectile dysfunction [20], vitamin D supplementation may be required. Flibanserin, a newly US Food and Drug Administration (FDA)-approved drug for premenopausal woman with hypoactive sexual desire, has not been studied in women with SCI. There are also some concerns around flibanserin lowering blood pressure [21].

Genital arousal disorders

Treatment for erection dysfunction (ED) in men includes the use of PDE5 inhibitors, which have been quite successful (> 80% response), especially in those with an upper motor lesion. Headache and facial flushing are common side effects and can be misinterpreted as AD. The main issues with the use of PDE5 inhibitors in men with SCI are that they can cause hypotension and dizziness in an already hypotensive population, and that they cannot be used with nitrates (which are traditionally used for angina, but can be used to treat AD). Starting with lower doses of *pro re nata* (prn) sildenafil citrate (Viagra®) and vardenafil (Levitra®), whose maximal effect is from 1 to 4 h after taking, is prudent due to their hypotensive effects. The use of tadalafil (Cialis®), prn or once daily, can also be beneficial, but has a longer lasting effect. In addition, daily low-dose use in quadriplegics may cause frequent unwanted erections.

Second-line choices for erection enhancement include the use of vacuum erection devices (VEDs). However, the ring should not be left on for more than 45 min because this can be a potential hazard in men who are genitally insensate. Perineal training for men who retain some innervation to their pelvic floor may assist with penile tumescence and make second-line therapies potentially more viable [22].

Third-line choices include invasive intracavernosal (penile) injections (ICIs) of single or mixed medications (prostaglandin E1, papaverine, and phentolamine) that directly relax the cavernosal smooth muscle. ICIs are very effective, but there is the risk of priapism in the SCI population. The intraurethral application of prostaglandin (alprostadil [MUSE®]) has not been very successful in the SCI population [23]. The fourth-line intervention, surgical penile prosthesis, is only utilized when reversible methods are not satisfactory. Highlights of specific considerations for erection enhancement in men with SCI can be found in other readings [24].

Orgasmic difficulties

Orgasmic potential in men and women with SCI can be improved by several factors. That is, interventions that increase genital stimulation improve awareness of sensate areas (e.g., through body mapping), and allow for cerebral inputs to be appreciated at a higher level may improve this potential. Allowing the freedom to focus by removing interferences (i.e., pain, spasticity, AD, and incontinence) through medical treatments can also help. The practice of mindfulness with sexual stimulation, and the use of relaxation, meditation, fantasy, recalling positive sexual

experiences, breathing, and "going with the flow" can also help improve orgasmic potential. Being with a trusted and long-term partner is the most predictive factor in orgasmic attainment after SCI [25].

Focusing on cerebrally initiated sexual response can, despite lost abilities, result in an adapted but satisfying sexual experience. The principles of neuroplasticity that were learned in motor rehabilitation after SCI can also apply to the sexual situation. Areas that remain sensate take on a sexually arousing role (i.e., neck and ear stimulation can lead to "eargasms" after quadriplegia), even if such areas were not in the sexual repertoire prior to injury. One small study on sensory substitution following SCI highlights the potential with these areas and the need for further study [26].

Multidisciplinary approach to sexuality after SCI

A biopsychosocial approach to sexuality requires multidisciplinary expertise. Physicians specializing in SCI are most qualified to educate and provide care for physiological issues that affect sexuality, such as neurologic dysfunction, the impact of fecal and urinary incontinence, pressure ulcers, AD and related cardiovascular issues. Other specialists must become familiar with SCI issues before they can become effective in their roles. Urologists trained in sexual medicine and gynecologists educated about sexual dysfunction and sexual health are best qualified to assist patients with rehabilitation of sexual function and advise on pro-erectile and vibrostimulation methodologies for men, and lubricants and vibrostimulation methodologies for women. Physical therapy experts in pelvic floor rehabilitation can provide patients with exercises that address urinary and fecal incontinence, erectile function and pelvic pain. They can also assist in training patients in vibrostimulation and help develop strategies for comfortable sexual positions. Trained sexuality counselors who are often nurses, physician assistants and physicians, certified by the American Association of Sexuality Educators, Counselors and Therapists (AASECT), can assist in providing education about the impact of SCI on sexuality, paths to rehabilitation and sexual aids teaching. AASECT-certified sex therapists are mental health providers who are trained to guide individuals and couples through the grief process which can sometimes manifest as barriers to sexual recovery and work with individuals to re-eroticize their bodies and couples to work towards a new sexuality.

Table 1 summarizes SIU-ICUD workgroup conclusions and recommendations for sexual therapy/treatments in SCI patients.

Male fertility after SCI

Men with SCI may have concerns about fertility (conception) potential but should be reassured that they can have realistic expectations of fatherhood.

Semen volume/quality

Many men with SCI cannot achieve ejaculation during intercourse or with masturbation without assistance. Emission of the semen is controlled by sympathetic nerve segments from T10 to L3. An injury above the vertebral level of T6–7 can interfere with the process of seminal emission and closure of the bladder neck. Forward propulsion of the semen can also be affected by loss of coordination of the bulbospongiosus/bulbocavernosus muscles, as well as the muscles of

Table 1 Sexual therapy/treatment for SCI patients

Conclusions
The vast majority of men and women with SCI find it difficult to become physically aroused, and more women than men have difficulty becoming psychologically aroused. **[LOE 2]**
Compared with placebo, PDE5 inhibitors are associated with significant improvement in erectile quality and tolerable side effects in men with SCI. **[LOE1]**
Intracavernosal injections are effective in treating erectile dysfunction among men with SCI. **[LOE2]**
Intraurethral agents (i.e., MUSE) are not effective for the treatment of erectile dysfunction in men with SCI. **[LOE4]**
PVS can help improve forceful ejaculation in men with SCI, particularly those with a higher level of injury. **[LOE 1]**
Vaginal moisturizers, lubricants, and vibrostimulation assist with genital arousal in women with SCI. **[LOE 2]**
Hormone replacement therapy may be required in some women with SCI to maintain the elasticity and lubrication ability of the vagina. **[LOE 3]**
Recommendations
Clinicians should offer men with SCI who have ED a PDE5 inhibitor as first-line therapy, and intracavernosal injections and vacuum erectile devices as second-line therapy. **[GOR A]** Intraurethral agents should be avoided. **[GOR B]**
Clinicians should offer vibrator therapy to men with SCI wishing to ejaculate or reach orgasm. **[GOR A]**
Men with SCI are at higher risk for, and should be tested for, low testosterone and should be treated if necessary. **[GOR B]**
Women with SCI should be offered vaginal moisturizers and lubricants, vibrators, and topical hormone replacement therapies. **[GOR B]**

the pelvic floor. These muscle group innervations depend on the somatic segments of S2, S3 and S4, which travel through the pudendal nerve [27]. Additionally, SCI men may experience anejaculation due to ejaculation dyssynergy between the external sphincter and the bladder, which results in loss of forward propulsion of sperm [28].

Semen analysis studies have also demonstrated low semen quality among men with spinal cord injury [29]. In general, sperm count is normal, but sperm mobility is reduced after SCI. This may be caused by inflammatory changes in the seminal fluid. Seminal plasma in SCI patients shows a large number of activated T cells that secrete cytokines such as interleukin-1, interleukin-6, and tumor necrosis factor-alpha, which researchers have linked to impaired sperm mobility [30]. Furthermore, it has also been shown that neutralization of these factors has resulted in improved motility of sperms [31].

Assisted male reproductive techniques

Men with SCI may benefit from assisted reproductive techniques to achieve pregnancy. If semen cannot be retrieved through masturbation, it may be possible to retrieve through PVS. First described by Brindley in the 1980s [32], PVS is performed by placing a vibratory device on the dorsum of the penis, which activates the penile dorsal nerve. With continued stimulation, the ejaculatory reflex arc is activated at the level of the spinal cord and ejaculation occurs [33]. Pregnancy outcomes for this technique have been reported to be as high as 43% when combined with vaginal self-insemination [34].

Electroejaculation (EEJ) is an alternative method for sperm retrieval. It is reserved for men who do not respond to PVS. During EEJ, a stimulator is placed by a physician inside the rectum, and the seminal vesicles/prostate/pelvic floor peripheral nerves are directly stimulated. Consequently, EEJ does not need stimulation of the spinal reflex to elicit ejaculation. Studies have shown that EEJ sperm have a lower motility rate than PVS sperm, but EEJ can be successful after PVS has failed [35]. Clinicians should be aware that sedation is frequently required for this procedure, and autonomic dysreflexia is common during EEJ in men with lesions above T6 [25].

Table 2 summaries SIU-ICUD conclusions and recommendations on Male Fertility after SCI.

Female fertility

Resumption of menses

In general, women have normal reproductive function after SCI. Neither the level of injury nor the completeness of the lesion seems to have an influence on the menstrual cycle over time [36].

The event of an SCI does induce a transient episode of acute amenorrhea immediately after the injury. Menses usually resumes after approximately 6 months (50% at 6 months and 90% at 1 year) and normalizes into a predictable cycle. By this time, most women with SCI have already left the rehabilitation center. It is, therefore, important that these women are adequately informed on this topic prior to discharge [37, 38]. Patients with SCI may experience increased premenstrual and menstrual symptoms, and some additional symptoms not present in able-bodied women, such as AD, and bladder and muscle spasms. Patients should be counseled to expect these changes [38].

Similar to menses, menarche also follows a predictable pattern in SCI females [39]. Although the injury can elicit menopause in a small number of premenopausal women (reported in 14% of subjects), this is relatively uncommon. Except for an increase in mood disorders, menopausal symptoms do not seem to differ greatly between SCI women and able-bodied women [40].

Experts have commented on a generalized low utilization of reproductive and gynecological health care for women with SCI [38]. This deficit is likely multifactorial and stems from a lack of knowledge regarding reproductive potential among both patients and providers, and the presence of physical barriers (e.g., wheelchair access) that reduce access. These factors can lead to unwanted pregnancies, and

Table 2 Male fertility after SCI

Conclusions
Fertility is impacted in men with SCI because of erectile dysfunction, ejaculatory dysfunction, and poor semen quality. **[LOE 2]**
Most men with SCI have normal sperm concentrations, but have low sperm viability and motility. **[LOE2]**
Surgical retrieval of sperm in men with SCI can be successful with PVS or EEJ. **[LOE 2]**
Recommendations
Clinicians should refer men with SCI and ED/fertility concerns to multidisciplinary care to help maximize sexual potential and increase the likelihood of pregnancy. **[GOR B]**
In SCI men desiring fertility, clinicians should discuss the potential of reduced fertility because of ejaculatory dysfunction and low sperm quality. Clinicians should also discuss infertility treatment options. **[GOR B]**

potentially delayed diagnoses of gynecological cancers and sexually transmitted diseases among SCI women [41].

Contraception

After the transient period of amenorrhea, most women with SCI will return to their preinjury fertile status. Although hormonal birth control can be prescribed to women with SCI, attention should be paid to some specific points. Due to increased thromboembolic risk, hormonal contraception should be avoided in the 1st year after SCI in women who continue to smoke and in women with a history of cardiovascular circulatory problems [38]. Some authors have counseled against hormonal contraceptives in SCI-injured women older than 35 years due to a general concern over reduced mobility increasing the risk of a hypercoagulable state [42]. Care should also be taken when prescribing depot medroxyprogesterone acetate (MPA) for birth control. Although MPA can comfortably diminish the amount of menstrual blood loss, it may also place SCI females at risk for increased bone loss, which is already a potential problem in this population [39].

Barrier methods (such as diaphragm or intra-uterine device) can be used for SCI women, but information should be given regarding the risk of pelvic inflammatory disease (PID). In SCI women, this risk may be higher compared with general population due to a higher prevalence of urinary tract infections among SCI females. Furthermore, PID-related pain symptoms might not be detected among SCI females due to sensory changes [38]. When discussing barrier methods of contraception, caregivers should also discuss with SCI women the risk of vaginal and uterine erosion.

Pregnancy complications

Although women with SCI can normally reproduce, the presence of an SCI does have important implications for pregnancy. In a retrospective survey of 114 women with SCI, only 23 of 114 women reported that they had received information on this subject during rehabilitation, and only 12 found this information adequate [43]. Pregnancy rates were higher when SCI was acquired at a younger age. There were no other predictive variables, including level of injury. This age-related difference is probably not fertility related, but is determined by many other factors, including the probability of receiving more education over time [40, 44].

During pregnancy, providers should be aware of the possibility of AD during pregnancy in women with SCI at the T6 level or higher. In these patients, AD has been reported to occur in 48–85% of women, and cases of AD have even been reported in individual patients with a lesion at the T8 level [45]. It is important for clinicians to also remember that labor can similarly cause AD. After ruling out pre-eclampsia as an underlying cause of hypertension and decompressing the bladder/bowels, clinicians should proceed with further treatment of AD, with specific attention to the fetus since overtreatment and hypotension cause fetal distress [41].

Urinary tract infections can also create potential problems in SCI women during pregnancy. In a review of published series by Pannek and Bertschy, 64% of pregnant SCI women experienced at least one symptomatic urinary tract infection during pregnancy [46]. Postvoid residual urine should be monitored and addressed if related to urinary tract infections. If necessary, this can include a change in bladder management strategy. Indwelling catheters should be avoided, as these can increase the risk of urinary tract infection. If necessary, intermittent catheterization can be started. Pyelonephritis should be avoided since it may induce preterm labor and delivery. In a prospective observational study, six women with SCI were given a weekly oral cyclic antibiotic schedule. This led to a significant reduction in urinary tract infections, without obstetric complications and with good infant outcomes [47].

Caregivers should also address the mobility and the reseating needs of pregnant SCI patients. In high-level (thoracic and cervical) lesions, pregnancy can induce changes in respiratory function, which might mandate adapted respiratory rehabilitation [48–50]. Throughout pregnancy, an upright-seated position has to be strived for and, if necessary, repetitive adaptations have to be made by the seating specialist [39]. Particular attention should be given to a changed cushion–skin interface, as the risk of decubitus ulcers also increases in this population due to a combination of weight gain, change of body habitus, and increased spasms, pain, immobility, and even anemia [51]. Lack of mobility may lead to an increased thrombosis risk [44]. Therefore, compressing stockings and low-molecular weight heparins from the 4th month onwards until the end of the postpartum period are advised [41].

Providers should also be aware that bladder and bowel symptoms may change during pregnancy in SCI women. In particular, SCI women may have increased constipation problems during pregnancy. Adequate fluid intake and, if necessary, mild laxatives can prevent this problem [41].

Last but not least, the psychological aspects of pregnancy should be considered. Very importantly, postpartum depression occurs more frequently in women with SCI [44]. Caregivers should reinforce that pregnancy and childbearing can be important issues in regard to QOL, despite all the other problems that can arise [37]. Tebbet et al. described this interaction between biomedical problems and social/psychological strain in SCI patients during pregnancy, counseling caregivers to address both simultaneously [51].

Table 3 Female fertility after SCI

Conclusions
Women with SCI will likely resume normal menses more than 6 months after injury. **[LOE 2]**
Fertility usually returns to its preinjury fertility status after SCI. **[LOE 3]**
Systemic hormonal contraception in SCI females can potentially increase the risk of thromboembolic events in the 1st year after SCI and may increase bone loss over time. **[LOE 4]**
Pregnancy in SCI patients is associated with higher rates of urinary tract infections and thromboembolic events for all injury levels, and is associated with AD for injury levels above T7. **[LOE 2]**
Pregnant women with SCI can have atypical symptoms of labor and are at increased risk for preterm labor. **[LOE 3]**
Recommendations
Women with SCI must undergo routine gynecological checkups and receive routine gynecological advice. **[GOR A]**
Clinicians must inform women with SCI that fertility usually returns to its preinjury fertility status. **[GOR A]**
Birth control must be offered to women of reproductive age after SCI. Different forms of contraception, and their advantages and disadvantages, should be discussed with patients. **[GOR A]**
Clinicians must monitor pregnant SCI patients for urinary tract infections and thrombotic vascular events. **[GOR A]**
Women with SCI should be counseled by a multidisciplinary team about the risks of pregnancy and followed regularly by a multidisciplinary team once pregnant. **[GOR B]**
Women with SCI should have discussions with obstetric physicians specializing in high-risk pregnancies to better understand the individual risks associated with a spontaneous vaginal delivery versus a planned caesarian delivery. [GOR A]
Cervical effacement and dilatation should be checked routinely from week 28 onwards, and SCI women should be hospitalized from week 36 onwards, or earlier if labor begins or if the cervix is dilated or effaced. **[GOR B]**

Labor and delivery risks

Clinicians should discuss labor and delivery plans with SCI women early in pregnancy. Since the uterus is innervated by T10–L1, women with higher spinal cord lesions may not sense the onset of labor. Furthermore, women with lesions at T10–L1 may experience insufficient labor contractions. With lower lesions, uterine sensibility is preserved.

Labor in the setting of an SCI can be indicated by very different signs and symptoms [38, 40]. Atypical signs include pain above the level of the injury, abnormal pain, ruptured membranes (which can be confused with urinary incontinence), increased spasticity in the legs/abdomen, respiratory changes, bladder spasms, or AD. Occasionally, no symptoms at all are present. Uterine palpation techniques or home uterine monitoring could be an aid [44, 49].

Moreover, SCI women tend to have more preterm deliveries. In a small series of 37 pregnant SCI women, 33% had a preterm delivery [44]. Cervical effacement and dilatation should be checked routinely from week 28 onwards, and SCI women should be hospitalized from week 36 onwards, or earlier if labor begins or if the cervix is dilated or effaced [52]. After delivery, there is a higher rate of low birth weight and a higher rate of admission to the neonatal intensive care unit. To prevent the consequences of AD, patients at risk should undergo general or epidural anesthesia with continuous blood pressure monitoring.

Due to the presence of contractures, heterotopic ossification, and severe spasticity, there is an increased rate of complications during delivery. Nevertheless, women with SCI can still have a normal vaginal delivery. Different series report between 37 and 53% of SCI women will have spontaneous vaginal deliveries [40, 49]. Women with SCI should have discussions with obstetric physicians specializing in high-risk pregnancies to better understand the risks associated with a spontaneous vaginal delivery versus a planned caesarian delivery.

Table 3 summaries conclusions and recommendations for female fertility after SCI.

Conclusion

A spinal cord injury can greatly impact fertility and sexuality for patients. However, there is reasonable expectation that spinal cord injured people can continue to remain sexual beings after the injury. Urologists should discuss physiology, treatment options, and potential complications related to sexual functioning and fertility and work with a multidisciplinary team including sexual therapists to help patients improve this important quality of life issue.

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Compliance with ethical standards

Human and animal rights statement This research did not involve human subjects or animals

Informed consent No informed consent was needed for this research

Conflict of interest J Stoffel—no conflict regarding this project, Frank Van Der Aa—no conflict, Daniela Wittman—no conflict, Shirish Yande—no conflict, Stacy Elliott—no conflict.

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