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Complications associated with hospitalization after spinal cord injury

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Abstract:

Background: Spinal cord injuries are a traumatic phenomenon not only for the physical sphere, but equally affect the human psyche. The patient ceases to be independent in his actions, he must face a completely new situation for himself and the environment. Particularly difficult is the first period after injury, associated with hospitalization. That is why it is so important to prevent the most common complications of spinal injuries during this period.

Material and methods: Analysis of available literature, articles in the Google Scholar and PubMed database using keywords: Spinal Cord, Injury, Trauma, Complications

Results: The most common complications associated with the hospital stay of patients with spinal cord injury include: complications in the respiratory system (including pneumonia, atelectasis and respiratory failure), decubitus ulcers, periarticular neurogenic ossification, autonomic dysreflexia, spasticity or disorders in the functioning of the urinary tract. Decubitus

ulcers due to their nature are a huge problem for hospitalized patients, in epidemiological studies it was estimated to occur at nearly 20 per cent. Spasticity is one of the most serious complications hindering the effective rehabilitation process of post-traumatic persons. In the case of disorders associated with the urinary system, it is important to classify dysfunctions based on the neurogenic evaluation of the sphincter muscles and detrusor.

Conclusions: Due to the increasing number of spinal cord and spinal cord injuries and the serious nature of their complications, this topic should continue to be an area of very intensive scientific research, both theoretical and clinical. The given issues should be familiar not only to the medical community but also to the family and the patient's environment.

Key words: Spinal Cord, Injury, Trauma, Complications

Introduction

The majority of hospital activities related to patient care, its positioning or prevention of pressure bedsores belong to people who have contact with the patient 24 hours a day. Nevertheless, all medical personnel must be familiar with the principles of proper patient care and observe them in order to prevent serious complications in patients in the most effective way. It consists in protecting the limbs against deformations, care of the bladder, prevention of pressure sores, protection of the skin and maintenance of the open airways. [1,2]

Post-traumatic periods in spinal cord injury

We distinguish four states that change with the time that has elapsed since the injury:

- period of core shock (otherwise sharp);
- regenerating-compensating;
- physiopathological stabilization;
- psychosomatic and socio-occupational adaptation. [3]

The sharp period is characterized by the so-called with a spinal shock, in other words, motor-sensory functions of the core are inhibited. Thus, during this period there is a cessation of the function of any muscle, concerning various areas depending on the level of injury and the abolition of sensation and inhibition of reflexes. These symptoms are accompanied by other symptoms such as: excretion disorders and dysfunctions in the gastrointestinal tract, changes in the skin that may affect the subsequent formation of pressure ulcers. The acute period lasts from 3 to 6 weeks.

For the regenerative-compensatory period, the appearance of spasticity is characteristic, it indicates the damage of the corticospinal tract. It is not always just spasticity, because sometimes the features of peripheral damage of the motor neuron are noticeable. The paresis or paralysis and the area they cover is directly related to the level of damage. Damage to the motor road on a given segment makes it impossible to central nerve the lower segments, which is manifested by spastic or palsy of the innervated muscles through the denervated area of the spinal cord. When the peripheral motor neuron fails, the symptoms are consistent with the segmental vein, adequate topographically to the lesion site. This period, also called the period of regression of symptoms, lasts from 3 to 4 months [3,4]

The period of physiopathological stabilization is in other words the period of perpetuation of irreversible changes, is characterized by an increase in spasticity and persistence of dysfunctions within the urinary tract and gastrointestinal tract. During this period, we also observe disorders in the movement organ caused by very long immobilization, such as: osteoporosis, contractures, or extraperitoneal ossification. The physiopathological stabilization lasts from 6 to 24 months.

The period of adaptation, otherwise known as the period of change, is the last period that lasts until the end of the patient's life. In such a late time after the injury, we already observe disorders of many body systems and psychological changes resulting from the current social and professional situation. This period is characterized not only by disorders of all types but also by the organism adapting both physically and mentally to the new situation. The later period, especially when physiotherapeutic and nursing care is inadequate, causes breakdowns in adaptive mechanisms due to lowering of overall efficiency or complications. Adaptation of the patient takes many years. [3]

Persons immobilized in a hospital bed require a change of body position every two hours. Areas of exceptionally endangered decubitus ulcers are: trochanters, occipital bone,

shoulders, sacrum bones and heels. It is recommended to place the patient on an anti-bedsore mattress while relieving the places exposed to bedsores through pillows or rollers.

It is also important to set the limbs to protect it from contractures. The right position for the upper limb is a slight visit in the brachioral and flexion joint. Elbow set in a multi-stage flexion, the forearm in the pronation position, and the wrist in a delicate dorsiflexion or neutral position. Put your hand on a rolled up towel or roller, with your fingers in a slight bend and the opposite thumb position.

Maintaining airway patency is equally important. Excess secretions are removed from the bronchial tree by suction, but also due to drainage and pattering of the chest.

The lower limb should be placed with an upright hip joint, if there are no other contraindications and it must be secured against external rotation by the fittings. The knee of the patient can be slightly bent by placing the roller. The feet must be secured against falling, for this purpose we set the soles at right angles to the shank axis. [5]

Complications in the respiratory system

They are very common in patients with complete spinal cord injury in the cervical section. The percentage of these people among patients is even 30%. Unfortunately, they can occur right after the injury when the diaphragmatic nerve centers are damaged. This damage results in paralysis of the diaphragm, and the victim is killed relatively often at the site of injury [6]

We talk about respiratory failure with total spinal injuries and is higher when the level of damage is higher. The study found that in patients with C1-C4 core injury, the incidence of respiratory failure was 40%, between C5-C6 - 23%, while in the thoracic segment only 9.9% (total - partial and total injuries) [7]

Breathing disorders are more often found when the cervical cord is deeply damaged. Disorders of the autonomic nervous system are the cause of these disorders. During spinal shock we are dealing with blocking the nerve centers located below, including the sympathetic trunk. The parasympathetic system, or vagus nerve, whose centers are located above the damage is still functioning. The predominance of the parasympathetic system causes contraction of the bronchial tree and increased secretion of bronchial glands. Bronchial spasm together with chest muscle paralysis responsible for breathing effectively prevent effective coughing, thus

expectoration of secretions. Therefore, hypoxia, atelectasis and blood oxygen disorder develop. The retained secretion can cause inflammation of the bronchi, which sometimes turn into pneumonia. In the current state of health of patients, this situation poses a serious threat to life. A very important parameter that is used to assess the possibility of respiratory failure is the tidal volume. Intubation is necessary when the functional capacity of the lungs is approximated to the tidal volume or falls below 1 L. [6]

Decubitus ulcers

A decubitus ulcer is a degenerative change caused by tissue exposure to pressure and abrasive forces. Pressure impairs or completely prevents proper blood circulation and causes necrosis of the tissue and formation of visible ulcers with a characteristic odor. Most often, bedsores are seen in the sacral area, because when lying back in bed it is the most stressed place, in which we have a very thin layer of soft tissue. In this position, our heels are also at risk of pressure sores. In a situation when we are dealing with a decubitus, or a situation in which it can easily arise, we arrange the patient on the sides, which also generates a risk of pressure ulcers, this time at the greater trochanter, medial side of the knees or around the ankles [6,8]

In several countries, studies on the incidence of pressure ulcers have been performed. About 5,947 patients from 25 hospitals in 5 European countries underwent the study. The incidence of pressure ulcers in patients was 18.1%, which shows the scale of this problem.

The decubitus ulcer has various stages of progression. The following division of pressure sores according to Shea is often used, although it is not the only one:

- cutaneous necrotic changes;
- changes that also affect the subcutaneous tissue;
- necrotic lesions including deep fascia;
- tissues below the fascia affected by the changes;
- changes include deep tissues and bone.

The first changes according to the classification should be treated conservatively, while the others should be treated with surgery. Many factors contribute to the formation of pressure ulcers, the most important of them is muscular paralysis, because the muscles cease to play the role of a pump that drains the residual blood, which prevents the inflow of arterial blood and

negatively affects tissue trophism. Other factors are the abnormal sensation of excessive pressure on the area and ventilation disorders in tetraplegics. Paralysis of the lower limbs affecting the patient's mobility is also one of the factors that put pressure on the bedsores. During treatment, an important aspect is the alignment of blood counts, electrolyte and protein metabolism disorders. Another priority in the treatment is relieving the pressure ulcer area from pressure. The treatment process must be preceded by cleaning of the pressure ulcer and removal of the inflammatory reaction. However, the best way to fight against pressure sores is to prevent them from arising. Important in this aspect are proper hygiene of the patient, frequent changes in body position and proper care [8,9]

Periarticular neurogenic ossification

Periarticular calcifications, as we also call these ossias, are bone tissue forming within connective tissue, tendons, and muscles. These ossifications are caused by spinal cord injuries, we also see them in polyneuropathy or in Heinrich-Medin's disease and many others. Ossification applies only to large joints, most often hip joints, and relatively less frequently is the knee joint, shoulder joint, scapulo-costal area. It is believed that calcification is a result of disorders of the vegetative system, although many other factors are mentioned as threatening factors, the effect of which on pathological ossification is not fully known. Ossification develops in places physiologically maladaptive, in addition to restrictions in the range of motion, it may damage the blood vessels or peripheral nerves. [10]

It is important when taking care of patients to pay attention to the characteristic symptoms that may occur: swelling, joint warming, limitation of joint mobility resulting from unknown reasons. It is worth knowing them well because we can react before radiological changes are visible. Properly conducted exercises have a good effect on keeping the range of movable property close to the correct one. Surgical ossification is treated only in the case of blockage in the joint in a position that does not allow the seated position to be taken. [9]

Autonomous dysreflexia

The complication is based on excessive and uncontrolled function of the sympathetic system. It occurs in patients with lesions of the cervical and upper thoracic segment. Many

factors, including the secretion of hormones, make up its formation. Symptoms of DA experience 50-70% of people with core injury above the Th 5 segment [10,11,12]

Excessive sympathetic nervous system activity results in vasoconstriction and increases in blood pressure. Then the vagus nerve should be stimulated causing the blood pressure to normalize, but this is not due to the spinal cord being broken and the signal can not be reached below the lesion. Among the symptoms we can distinguish:

- nausea
- chills and sweating
- significant increase in systolic pressure
- pulsing headaches
- decreased vision

The above symptoms may be caused by: full bladder, sexual intercourse or irritation of the urinary tract, or their infection even in 85% of cases, then the therapeutic procedure is symptomatic

Spasticity

Spasticity according to the theory Lance is a movement disorder characterized by increased tonic tendon reflexes in response to stretching, depending on the speed of stretching.

Typically, paralysis, paresis, pathological reflexes, or melasma are also observed in spasticity. Spasticity also includes paralysis, paresis, the presence of pathological reflexes, or foot clonus. All these complications are called the upper neuron syndrome. This syndrome arises when the pyramidal pathways of the motor cortex, spinal cord or brainstem are damaged. Before spastic muscle tension occurs, they are flaccid and tendon reflexes are weakened. This condition can last even a few months before we have to deal with spasticity. It is the beginning of muscular-tendon contractures, instability of joints, stiffness and bone deformities [13,14].

Spasticity in clinical terms is manifested, inter alia, as follows:

● spastic dystonia - incorrect posture due to constant muscular tension

● violent contractions - involuntary repetitive muscle activity

- intensification of reflexes - slowing depressions with increased amplitude
- excessive resistance when performing passive motion.

The causes of spasticity are not fully explained. We know, however, that this is a disturbance of the balance between the mechanisms stimulating and inhibiting the activity of our spinal cord motoneurons alfa and gamma [15, 16].

Disorders in the functioning of the urinary system

The neurogenic bladder is a symptom of damage to the roads or nerve centers that are responsible for controlling the micturition. The type of dysfunction, the degree of nerve damage, co-morbidities and accompanying ailments, all of these factors depend on treatment in such cases. The overriding aim of treatment of such disorders is to prevent damage to the upper urinary tract, to minimize discomfort associated with urinary incontinence and to prevent recurrent urinary tract infections in the patient. The neurogenic bladder may occur in many diseases related to neurological problems, it may be damage to the spinal cord, brain tumor, or Parkinson's disease, Alzheimer's disease, multiple sclerosis and others [17].

Considering the complexity of this disease, it is important to precisely determine with what type of bladder dysfunction we have to deal with in order to select the therapeutic methods in the future. International Continent Society (ICS) is an organization that has established the principles of diagnosis and treatment of patients who suffer from such dysfunctions and systematized naming. The main assumptions include the recognition of the bladder as one functional unit together with the urethra. The proper functioning of the lower urinary tract depends on the proper cooperation of various muscle structures. The urinary storage phase is clamped with sphincters and the detrusor is relaxed. In the micturnal phase, the opposite - sphincter relax and the detrusor shrinks. There are four basic types when it comes to the neurogenic vesicourethral dysfunction that Madersbacher identified. [18] Two muscles play a key role in this division: the detrusor and sphincter. Damage to the nervous system causes paralysis of these muscles called flaccid and spastic. The four types of neurogenic bladder presented and described in the table can be determined by urodynamic examination [19].

type	detrusor muscle	sphincter muscle	symptoms
I	spastic (hyperactive)	spastic	▪ frequent urination in small amounts ▪ increase in pressure in the urinary bladder during micturition ▪ inability to empty the bladder to the end ▪ very large retention of urine ▪ thickening of the bladder walls in the advanced stage of the disease ▪ urinary retraction, i.e. bladder - ureter reflux
II	spastic	slack (underactive)	▪ occurrence of increased urge incontinence during urge ▪ the bladder can not fill
III	slack	spastic	▪ the occurrence of very high retention of urine ▪ excessive stretching of the bladder walls with the risk of their damage ▪ leakage of urine drops with very large bladder filling ▪ the occurrence of ineffective urination using the abdominal press
IV	slack	slack	▪ urinary incontinence with paradoxical increased urinary retention in the bladder ▪ inability to completely empty the bladder ▪ permanent urine dripping from the bladder

Table 1. Classification of neurogenic vesicourethral dysfunction.

(developed based on [19])

Diagnostic tools allowing to determine the type of therapy are:

- a general urinalysis
- intravenous urography (evaluation of renal function and presence of kidney stones)
- cystoscopy (internal assessment of the bladder)
- urodynamic examination, which determines the functioning of the lower urinary tract.

Patients in the early period after the spinal cord injury, i.e. the spinal shock period, have to undergo medical treatment because the micturition center does not function.
This procedure protects the patient against the consequences of neurogenic dysfunction.
It is considered that the patient's condition stabilizes after about half a year, therefore urodynamic tests are not performed until that time.
During this period, the drain is secured with a Foley or Gibbon catheter. A suprapubic fistula with a Pezer catheter inserted into it is also made, it should have a smaller cross-section from the urethra, thanks to which it is possible to drain the tubular secretion.
It is important to start intermittent catheterization as soon as possible to improve the emergence of bladder automatism. If it is necessary to use the catheter for a long time, it should be clamped for a few hours so that the bladder is filled with urine to about 200-300 ml. [3,7,20]

After the period of spinal shock, when the patient has a damaged core above the micturition center, the bladder develops automatically. Urine is regularly donated with little deposition. When we observe an overactive detrusor muscle in the patient, when the sphincter is too high, we are talking about detrusor-spasmodising disorder. It is the reason for too high pressure in the bladder and urinary retreat to the ureters. Such bladder overflow in connection with a damaged core above the Th6 level may cause autonomic dysreflexia already described in this chapter. [11]

Bladder automatism is associated with a return to the detrusor's detrusor function. It is characterized by strong periodic contractions of the bladder muscles, thanks to which even complete emptying occurs. This is a very good phenomenon for the patient, because he can empty the bladder at similar intervals. It is also possible to learn to capture the moment when the bladder is full. Knowing this, the patient can stimulate urination using known techniques, such as deep breathing and sitting. [3]

Patients with spinal cord injuries are often treated in accordance with the principle of aspiration to create an automatic bladder through training, the level of damage or the urodynamic parameters mentioned above are not taken into account. It's about Crede's procedure, it's about compressing the bladder from the outside and external stimulation based on tapping the suprapubic region to provoke a contraction spasm. These methods were categorically rejected by the greatest scientists in this field of medicine. They have little effectiveness because the bladder is not completely emptied. Tapping, in turn, causes a contraction spasm and a detrusor, i.e. the aforementioned disruption, in addition, results in high fictional pressures and far too much urine retention. The basis for the treatment of neurogenic bladder is complete emptying of the bladder at low micturition pressure and protection of the upper urinary tract from damage. [21]

Urinary calculi is a frequent urological incidence later. Bone demineralization, abnormalities of phosphorus-calcium metabolism, or increased urinary calcium excretion directly affect the accumulation of stones in the urinary tract. [7]

Summary

The quality of life of patients with spinal cord injury is greatly deteriorated, not only because of physical disabilities, often limited social contacts and difficult employment opportunities, but also the role of urinary tract disorders plays a significant role. Frequent catheterization, the use of diapers often leads to problems in maintaining hygiene, which is an embarrassing situation for the patient and, as a consequence, may lead to limiting social contacts with others and even depression. [7]

People with spinal cord injury are exposed to numerous problems encountered in the hospitalization process to a large extent due to prolonged immobilisation. During this period, the most important is patient health care, because the majority of the complications described above can be avoided through consistent treatment of the patient. In such cases, the work of medical personnel is a key element leading to the improvement of the patient's quality of life.

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