

UROINFECTIONS IN THE PATIENTS WITH A TRANSVERSAL SPINAL CORD LESION

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Submitted: 2012-02-29

Accepted: 2012-09-24

Published online: 2012-12-20

Abstract

Spinal cord lesion is one of the most serious injuries. The patients with a transversal spinal lesion need a specialized, coordinated care. Spinal cord injury doesn't lead only to losing the ability to move the extremities. The patients also suffer from sensitivity loss under the level of the spinal lesion, urination disorders, defecation, sexual functions, breathing etc. There is a risk of many serious health complications for the patient. Due to these reasons, the therapy is lead in specialized center employing multidisciplinary teams of professionals. After the injury, it is necessary to change the position of the patient accordingly, as it is a significant risk factor for pressure ulcers. In the patients with a neck or upper thorax lesion, difficult coughing out is a common complication leading to increased risk of the airways infection. Urinary tract infection is another severe complication. They develop due to an undiagnosed or an incorrectly treated neurogenous lower urinary tract dysfunction caused by the spinal injury. The authors monitor the urinary tract infections situation in one of the specialized center for the clients with a transversal spinal lesion – Spinal rehabilitation ward in the Rehabilitation center Kladruby. The ward has been operational for 9.5 years and the uroinfections pose a serious complication for the patient. In the monitored complications incidence, they are listed on the second place of all the nine places.

Key words: uroinfection; transversal spinal cord lesion; spinal cord injury; bladder; defecation

INTRODUCTION

The spinal cord injuries treatment in the Czech Republic has been in a great part developed by Vladimír Beneš who introduced a compact nursing and rehabilitation care in paraplegics in 1961, proceeding from the English school of sir Ludwig Guttman. He described the neurology centers where the patients were gathered. Due to this change, the mortality rate decreased from 80% to 20%. There were no specialized centers of this kind in the Czechoslovak Socialistic Republic. Many specialists tried to implement this unified system of spinal cord injuries complex care (Wendsche et al. 2009).

Health ministry of the Czech Republic issued a Methodic measure in June 2002 introducing a network of spondylosurgery centers in the Czech Republic. In these centers, spinal injuries are to be treated in accordance with the latest guidelines and recommended standards. They are connected with spinal centers and then spinal rehabilitation wards in rehabilitation centers (the bulletin of the Health ministry of the Czech Republic, section 6/2002).

The paraplegiologic forum was founded in 2004 and it transformed into a new organization in the autumn of 2007 – “Česká společnost pro míšní léze” (The Czech organization for the spinal

cord lesions”). The Czech organization for the spinal cord lesions of the organization ČLS JEP (The Czech medical organization of Jan Evangelista Purkyně) aims to provide therapy and rehabilitation care for the individuals after a spinal cord injury in accordance with the latest, state of the art medical methodologies (Wendsche et al. 2009).

Urology care begins immediately after the injury and focuses on the prevention of the complication. Treatment of the bladder dysfunctions caused by the injury is pharmacologic, prosthetic, chirurgic or combined.

Urinary system

The urinary system consists of kidney, renal calyces, renal pelvis, ureter, bladder and urethra. The basic role of the urinary system is preservation of homeostasis in the organism. The bladder (vesica urinaria) is a hollow organ with thin walls. It works as a urine container. Urination urge develops at various filling level individually (250–280 ml). Then, a reflex action of the bladder voiding begins – urination. Urination is controlled from a central nervous system area. The basic urination reflex is controlled by an urination center position in the sacral part of the spinal cord. Reflex contraction of the compression release system of the bladder wall and loosening of the constrictor system (the internal sphincter – the internal sphincter muscle of urethra [m. sphincter urethrae internus] and the external sphincter – the external sphincter muscle of urethra [m. sphincter urethrae externus]) leads to urine drainage into the urethra. Pelvic floor muscles contraction is essential for a secure closure of the pelvic floor. Urinary center disorders are most commonly caused by an injury of the spine (Dylevský 2009).

Urine derivation

Urine derivation is a term used for urine drainage using a way different from the normal ways. It is possible to use external or internal catheters; a further option is a surgery modification of the urinary tract. Permanent catheter is used due to inability to urinate spontaneously. The duration of the catheter insertion is determined by the physician, the intervals between the changes depend on the individual situation

of the patient, the most common replacement interval is 3 weeks. The catheter is connected to a collection bag or closed with a plug. The permanent catheter usage is associated with higher risk of infections and possibility of its obstruction. The team of Macek, Hanuš and Herle mention a possibility of epicystostomy procedure solving the urine derivation mainly in the patients who don't want to have the permanent catheter or don't tolerate it, e.g. due to infections. Epicystostomy is suitable mainly for the patients with the neurogenous bladder; it is associated with a lower infections risk. The insertion procedure is done by an urologist. It consists of urinary catheter insertion through the abdominal wall. If the epicystostomy catheter falls out, the patient should visit an urologist as soon as possible, as the reinsertion through the previously created canal is possible at that time. Otherwise, a new bladder puncture will be necessary (Macek et al. 2011). Intermittent catheterization – one-time catheterization after 3–4 hours performed by a professionally trained nurse is possible to be done after a spondylosurgery examination and patient stabilization. Intermittent autocatheterization is a further option; it is possible to be performed if the patient is able to do the catheterization himself/herself (Kříž 2009). Bladder function assessment is performed via a basic diagnostic method – urodynamics. Based on the results, it is possible to determine an appropriate therapy of urination disorders. Neurogenous bladder – nervous lesions at various levels can cause bladder voiding or disorders of the bladder container function. The lesions are divided by the lesion level to supranuclear lesions and infranuclear lesions (Eichenauer and Vanherpe 1996).

Ascendant urinary tract infections were fatal for the patients with a transversal spinal cord lesion before the antibiotics development. The patients who had sustained the above mentioned injury died soon due to infections from pressure ulcers and ascendant urinary tract infection. During the 2nd world war, it became a serious illness in association with the antibiotics development. Pfeifer recommends inducing the spontaneous urine voiding using the inborn reflex by irritating the skin in the lower abdomen area after a certain time period. The consumed fluids need to be controlled. If this urine derivation

way is not possible, it is necessary to use a urinary (condom) drainage device. It leads the urine to a plastic bag connected to the shank (Pfeiffer 2007). Sutorý doesn't recommend urination induced by hand tapping. He claims that during this kind of urination, there is a detrusor-sphincteric dyssynergy associated with a urine residuum and a various level of urine incontinence. Due to these reasons, the tapping and abdominal pressure urination are not recommended anymore (Sutorý 2009b). Pfeiffer describes further possibilities of urine derivation. He doesn't recommend using the permanent urinary catheter introduced to the bladder. The reason is the urine flow through the bladder without its shrinking and extending. This situation leads to size reduction of the bladder. Chronic urethral sphincter extension is another problem. It causes urine dripping from the urethra after the catheter removal and there are more urinary tract infections. Ascendant renal infusions are very dangerous (Pfeiffer 2007). Urinary infections appear in 60–90% in causal correlation with the permanent catheter insertion and are one of the most common nosocomial infections (Sedlářová 2011). Chronically inserted permanent catheter is associated with a risk of chronic urine drainage and voiding of a small amount of the urine. The bladder wrinkles and becomes spastic (Seidl and Obenberger 2004).

Kříž warns of the chronic renal failure danger. He describes incorrect urinary derivation in patients with a spinal cord lesion leading to a possible urine reflux and the pyelonephritis development. It can be a later cause of a chronic renal failure (Kříž 2009).

The most effective derivation method, when adhering to the correct procedures, is the intermittent catheterization. The mentioned way minimizes the infections development (Sutorý 2009b).

Pure intermittent autocatheterization removes the urine residuum from the bladder that would cause infections. It is an important preventive measure for the urinary system complications. Therefore, it is a commonly indicated method. The physician and the nurse inform the patients (Klusoňová and Pitnerová 2005). Pfeiffer mentions that in spastic contraction of the bladder, it is recommended to do the one-time catheterization. The paraplegic patients

practice themselves; usage for a tetraplegic patient is complicated. The last possibility are the diapers (Pfeiffer 2007). The diapers are a bad solution, they increase the possibility of a sore, lead to bacterial and yeast growth and to more frequent urinary and gynecologic infections occurrence (Sutorý 2009b).

1. The aim of the project was to monitor the urine derivation in the patients with a transversal spinal cord lesion in the years 2010 and 2011.
2. To perform a urine cultivation test in every patient at the admission to the hospital and to monitor the difference of the infectious agent, depending on the different ways of the urinary derivation. To determine the difference between the most commonly repeating infectious agent at the admission examination with and the infectious agents from all the positive cultivations and the infectious agents in uroinfections with the general clinical signs treated with antibiotics and chemotherapeutics.
3. To compare the number of all the found positive cultivations with the uroinfections count with the general clinical signs treated with antibiotics and chemotherapeutics.

METHODS AND MATERIAL

After data acquisition, the secondary analysis of documents method was chosen. The analysis was focused on the quality indicators results from July 2002, statistic data and documentation of the patients after the founding of the rehabilitation ward. To extend the spectrum of the data needed for the determined aims analysis, i.e. the area of the urine derivation, uroinfections, infectious agents, urine cultivation in every admission examination was launched. Similarly, the specified data was monitored. The data are shown in absolute counts or percents.

The cohort characteristics

The research was performed at the spinal rehabilitation ward in the Rehabilitation center Kladruba in the period of 2010 and 2011. In the year 2010, 127 patients with a transversal spinal lesion were hospitalized at this ward, in the year 2011, 143 patients. In every patients, urine cultivation was performed at the admission examination.

RESULTS

There were 127 patients with a transversal spinal cord lesions hospitalized at the spinal rehabilitation ward in 2010, 143 patients in 2011. The patient count and the lesion level according to ASIA score (American Spinal Injury Association) are shown in Table 3. In the years 2010 and 2011, altogether 270 patients with various ways of the urine derivation were hospitalized (Table 1). In 2010, there were 42 (33.1%) patients with epicystostomy, in 2011, 41 (28.7%) patients. Permanent catheter was

inserted in 4 (3.1%) patients in 2010, in 33 (23.1%) patients in 2011. Clean permanent catheterization was used in 3 (2.4%) patients in 2010 and 6 patients (4.2%) in 2011. The most common urine derivation way in the both followed year intervals was the clean intermittent autocatheterization. In 2010, there were 61 (48.0%) patients with clean intermittent autocatheterization, in 2011, 43 (30.0%) patients. 17 (13.4%) patients were voiding via spontaneous urination in 2010, in 2011, there were 20 (14.0%) such patients.

Table 1. The total patients number, their division according the urine derivation way, the number of uroinfections with general clinic signs (treated with antibiotics and chemoterapeutics) in the individual urine derivations in 2010 and 2011

| Year | EPI | PC | CIC | CIAC | SU | Total |
|------|------------|------------|----------|------------|------------|------------|
| 2010 | 42 (33.1%) | 4 (3.1%) | 3 (2.4%) | 61 (48.0%) | 17 (13.4%) | 127 (100%) |
| URO | 24 (57.1%) | 4 (100%) | 0 (0.0%) | 5 (8.2%) | 2 (11.8%) | 35 (27.6%) |
| 2011 | 41 (28.7%) | 33 (23.1%) | 6 (4.2%) | 43 (30.0%) | 20 (14.0%) | 143 (100%) |
| URO | 18 (43.9%) | 16 (48.5%) | 0 (0%) | 5 (11.6%) | 1 (5.0%) | 40 (28.0%) |

Explanations: EPI = epicystostomy
 PC = permanent catheter
 CIC = clean intermittent catheterization
 CIAC = clean intermittent autocatheterization
 SU = spontaneous urination

Urine cultivation was performed in the admission examination in all the patients of the spinal rehabilitation ward. In 2010, positive cultivation in the admission examination was found in 79 (62.2%) patients, in 2011 in 93 (65.0%) cases. During 2010, positive cultivation results were found in 124 (97.6%) cases, in 2011 in 202 (141.3%) cases. The targeted antibiotics or chemoterapeutics treatment was performed only in the uroinfections with clinical signs, in 2010 in total 35 (28.2%) cases and in 2011 in 40 (19%) cases. In the individual urine derivation ways, the above mentioned therapy appeared in the following way (Table 1). In 2010 in the patients with EPI in 24 (57.1%) cases, in the patients with a permanent catheter in 4 (100%) cases, in the patient using the clean intermittent catheterization, there was no case registered, 5 (8.2%) cases appeared in the patients using the clean intermittent autocatheterization and in the patients with spontaneous urination, the treatment was performed in 1 (5%) case.

In 2011, the antibiotics and chemoterapeutics treatment was performed in the patients with the EPI in 18 (43.9%) cases, in 16 (48.5%) cases in patients with a permanent catheter, in patients using the clean intermittent catheterization, there was no antibiotics or chemoterapeutics treatment similarly to the year 2010, in the patients using the clean intermittent autocatheterization, there were 5 (11.6%) treatment cases and in patients with spontaneous urination 1 (5.0%) case.

From the beginning of the spinal rehabilitation ward function in the second half of the year 2002, 9 complications are monitored in the patients with a transversal spinal cord lesion. One of those is uroinfections treated with antibiotics and chemoterapeutics. They are listed on the 2nd place, after the pressure ulcers. The next places behind the uroinfections are: depressions, spasticity, phlebothromboses, MRSA, calcification, pneumonia, reoperations. Uroinfections numbers are listed in Table 3 with the hospitalized

patients numbers and the ASIA score. In the physical examination of a spinal patient, classification ASIA (American Spinal Injury Association) is used world-wide – a standard for neurologic classification of a spinal injury. It is divided into two neurologic lesion levels (according to the motor and sensitive level)

and lesion extent (ASIA Impairment SCALE – abbreviation AIS A-E). Categorization and numbers of the patients are listed in Table 3. E means without a neurology deficit, it is not listed in Table 3, as there was no patient eligible for this category.

Table 2. Positive cultivation at the admittance, during the year, the treatment of the uroinfections with clinic signs – treated with antibiotics and chemoterapeutics during the year

| Year | Total admittance examinations | Positive cultivation admittance examinations | Positive cultivation total | Treatment |
|------|-------------------------------|--|----------------------------|------------|
| 2010 | 127 | 79 (62.2%) | 124 (97.6%) | 35 (28.2%) |
| 2011 | 143 | 93 (65.0%) | 202 (141.3%) | 40 (19.0%) |

Table 3. Total number of the patients, ASIA, uroinfections with general clinical signs treated with antibiotics and chemoterapeutics

| Year | Total | ASIA | | | | Uroinfection |
|----------|-------|------|----|----|----|--------------|
| | | A | B | C | D | |
| 1/2 2002 | 65 | 33 | 17 | 15 | 0 | 18 (27.7%) |
| 2003 | 117 | 53 | 21 | 43 | 0 | 39 (33.3%) |
| 2004 | 101 | 57 | 27 | 17 | 0 | 20 (19.8%) |
| 2005 | 109 | 37 | 16 | 28 | 28 | 12 (11.0%) |
| 2006 | 116 | 39 | 25 | 40 | 12 | 5 (4.3%) |
| 2007 | 117 | 48 | 13 | 44 | 12 | 12 (10.3%) |
| 2008 | 112 | 36 | 9 | 27 | 40 | 10 (8.9%) |
| 2009 | 126 | 51 | 6 | 47 | 2 | 11 (8.7%) |
| 2010 | 127 | 37 | 10 | 44 | 36 | 35 (27.6%) |
| 2011 | 143 | 34 | 20 | 51 | 36 | 40 (28.0%) |

Explanations: A = total motor and sensitive lesion under the level of the injury including the S4–S5 segments
 B = total motor lesion, the sensitivity retained over the lesion level including S4–S5 segments, but there is no motor function
 C = subtotal lesion with the motor function retained in more than 1/2 of the key muscles under the neurology level on the stage lower than 3
 D = subtotal lesion with the motor function retained in more than 1/2 of the key muscles under the neurology level on the stage higher than 3

In the admission examination – urine cultivation, the infectious agent types were monitored in association with the urine derivation way. The highest type count, i.e. 14 infectious agents, was found in epicystostomy, the second one was the clean intermittent autocatheterization (12), followed by the permanent urine catheter (11), in patients with spontaneous urination, there were 8 types

and in clean intermittent catheterization, 4 infectious agents types were found. Without correlation with the urine derivation way, the most common bacteria were in all the types *Klebsiella pneumoniae*, *Escherichia coli*, *Proteus mirabilis*, *Pseudomonas aeruginosa*. In Table 4, the percent ratio of the 4 most commonly appearing analyzed infectious agents are listed. The mentioned finding

about the appearing infectious agents in the admission examination doesn't differ from the most commonly appearing infectious agents in all the positive cultivations in the years 2010 and 2011. In the majority of the positive cultivation cases in 2010 and 2011, the urine examination was done at the admission or it was a positive control

cultivation or positive cultivation before the planned urodynamic examination. The same 4 infectious agents found in the positive cultivation at the admission and during the years 2010 and 2011 are commonly found even in uroinfections treated with antibiotics and chemotherapeutics.

Table 4. Incidence of the infectious agents in the individual urine derivation types

| Infectious agent | Total | | EPI | | PC | | CIC | | CIAC | | SU | |
|-------------------------------|---------------|---------------|--------------|--------------|-------------|--------------|-------------|-------------|--------------|--------------|--------------|--------------|
| | 2010 (127) | 2011 (143) | 2010 (42) | 2011 (41) | 2010 (4) | 2011 (33) | 2010 (3) | 2011 (6) | 2010 (61) | 2011 (43) | 2010 (17) | 2011 (20) |
| <i>Klebsiella pneumoniae</i> | 58 45.7% | 44 30.8% | 13 31.0% | 8 19.5% | 4 100.0% | 12 36.4% | 2 66.7% | 1 16.7% | 17 27.9% | 20 46.5% | 7 41.2% | 4 20.0% |
| <i>Escherichia coli</i> | 43 33.9% | 29 20.3% | 3 7.1% | 1 2.4% | 4 100.0% | 5 15.2% | 1 33.3% | 1 16.7% | 15 24.6% | 11 25.6% | 9 53.0% | 10 50.0% |
| <i>Proteus mirabilis</i> | 27 21.3% | 16 11.2% | 10 23.8% | 10 24.4% | 3 75.0% | 2 6.1% | 0 0% | 1 16.7% | 7 11.5% | 2 4.7% | 3 17.6% | 1 5.0% |
| <i>Pseudomonas aeruginosa</i> | 24 18.9% | 7 4.9% | 18 42.9% | 5 12.2% | 3 75.0% | 1 3.0% | 0 0% | 0 0% | 2 3.3% | 0 0% | 0 0% | 1 5.0% |

Explanations: EPI = epicystostomy
PC = permanent catheter
CIC = clean intermittent catheterization
CIAC = clean intermittent autocatheterization
SU = spontaneous urination

DISCUSSION

In the year 2010, the clean intermittent autocatheterization was used in 48% of the patients, in the year 2011 in 30% of the patients. In both years, this urine derivation way in the patients with a transversal spinal cord lesion was the most used one. The intermittent autocatheterization is recommended, if the patient is able to do the catheterization himself/herself (Kříž 2009). Pfeiffer is of the same opinion, however he shows that one-time catheterization is far simpler for a paraplegic patient. In a tetraplegic patient, the practicing situation is more complicated (Pfeiffer 2007).

Sutorý warns that every urine derivation poses a risk of infection. He describes the factors leading to the urinal system infection development in the patients with a transversal spinal lesion. Permanently inserted catheter or drainage in the epicystostomy have a bacterial film on the surface. Similar to the one-time catheter insertion, there is a risk of the infection spreading from the frontal part

of the urethra. Even patient with spontaneous urination have some risks. The majority of them do not void fully creating conditions for an infection development and sustaining. The further factor is a non-physiologic pressure in the urinary tract. It leads to sustaining the infection and increase the risk of its relapse (Sutorý 2009a). In Table 4, you can find that the infectious agent can be found in every urine derivation way and the urinary tract dysfunction with pathogenic colonization is a part of the basic diagnose in the majority of the patients. Uroinfection treated with antibiotics and chemotherapeutics appeared in 27.6% of all the positive urine cultivation in 2010 and in 28% in 2011.

The stated treatment was performed in all the urine derivation ways in 2010 and 2011, except for the patients with the clean intermittent catheterization. In this group, there was no antibiotics or chemotherapeutics treatment in any case – Table 1. It is clear from the results that we follow the current recommended procedures of the urology organization – to treat the uroinfections only

with general clinic signs and not only the positive results of urinary cultivation that could lead to development and increase of the pathogens resistance. Sutorý mentions that a positive bacteriology finding is no indication to begin an antibiotic therapy in any case (Sutorý 2009a). The most common infectious agents in positive cultivations at the admission examination in 2010 and 2011 and in uroinfections treated with antibiotics and chemotherapeutics were *Klebsiella pneumoniae*, *Escherichia coli*, *Proteus mirabilis* and *Pseudomonas aeruginosa*. In the professional literature, these bacteria are the most common bacteria in the urinary tract. Schindler states that the most common type from some escherichia strains is *Escherichia coli* that is the most common source of the urinary infections both in the community and in the hospital (Schindler 2010). The *Escherichia coli* is then mentioned as the main nosocomial pathogen leading to inflammatory diseases of the airways and urinary tract. They persist in high moisture environment and on poorly cleaned instruments. In this contexts, pseudomonade is mentioned (Göpfertová 2002). The second most common source of urinary infections in the hospital and in the community as well is *Klebsiella pneumoniae*. *Klebsiella* has a natural resistance to ampiciline and carbapenem. Other very common sources of urinary infections both in the community and in the hospital are *Proteus mirabilis* and *Pseudomonas aeruginosa*. *Proteus mirabilis* complicates urolithiasis in women and complicates the therapy in chronically inserted catheters in hospitals. *Pseudomonas aeruginosa* is relatively resistant to antibiotics; it is treated with specific antipseudomonade antibiotics (Schindler 2010).

The patients with a transversal spinal lesion have high risk of many complications. Urinary retention and urinary infections, pressure ulcers, thrombembolism, pain therapy and spasticity are often emphasized (Hrabálek 2011). From the beginning of the spinal rehabilitation ward function in the second half of the year 2002, complications are monitored in the patients with a transversal spinal cord lesion (Table 3). Uroinfections with general clinical signs, treated with antibiotics and chemotherapeutics, are listed on the 2nd place after the pressure ulcers. On the next places, there are depressions, spasticity,

phlebothromboses, MRSA, calcification, pneumonia, reoperations. The results show a clear uroinfections incidence decrease in the years 2005–09. The authors state that it is not caused by a change of the health care providing system in the center, but probably only by a different patients structure. No direct connection has been found between the spinal cord lesion extent and the number of uroinfections. The uroinfections of every ASIA classification levels appear.

CONCLUSION

In 2010 and 2011, all the cases with positive urine cultivations and uroinfections with general clinical signs treated with antibiotics have been recorded. In every patient, an entry urine cultivation was performed. The results show that the urinary tract dysfunction with the pathogen colonization is a part of the basal diagnosis in the majority of the patients with a transversal spinal cord lesion. The targeted antibiotics and chemotherapeutics therapy was provided only in a quarter of the cases, corresponding to the current guidelines of the urology organization – to treat the uroinfections only with general clinic signs and not only the positive results of urinary cultivation that could lead to development and increase of the pathogens resistance. Antibiotics and chemotherapeutics treatment due to general clinic signs was recorded in all the urinary derivation types, it didn't appear only in the patients with the clean intermittent catheterization in any case in both the monitored periods. The most common infectious agents at the admission examination, independently on the urinary derivation type, were *Klebsiella pneumoniae*, *Escherichia coli*, *Proteus mirabilis* and *Pseudomonas aeruginosa*. These types appeared as the most common ones in the detected positive cultivations during all the year 2010, 2011 and on and in uroinfections treated with antibiotics and chemotherapeutics. In both the monitored years, the best urinary derivation way in hospitalized patients was the clean intermittent autocatheterization. The stated urinary derivation way lowers the infections risk, but what is more important, it offers independence to the patients. In all the stated urinary derivations, the same infectious agents have been proven.

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