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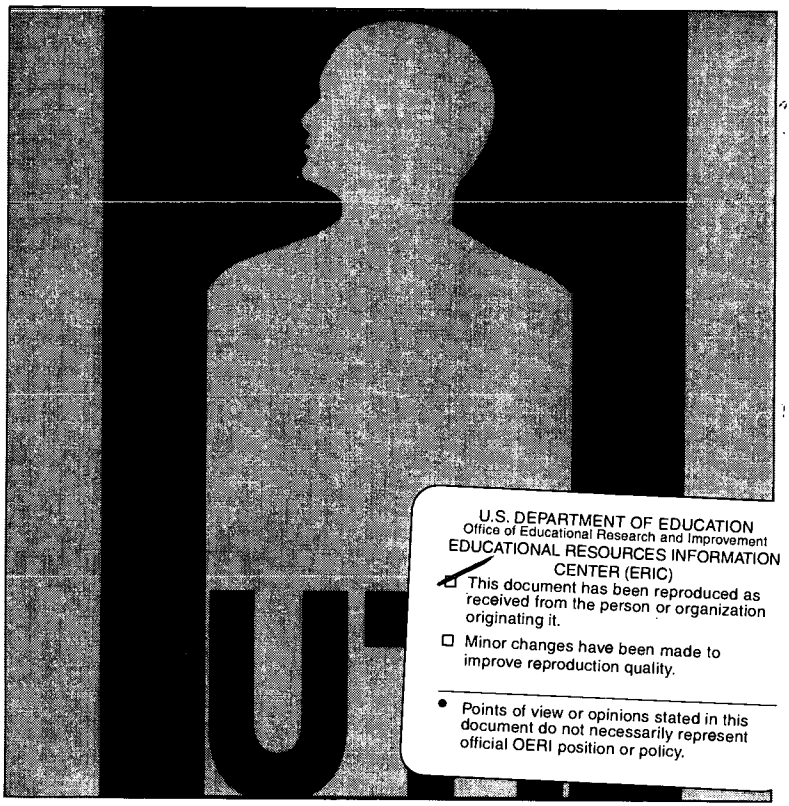
ABSTRACT

A 1992 Urinary Tract Infection Consensus Validation Conference brought together researchers, clinicians, and consumers to arrive at consensus on the best practices for preventing and treating urinary tract infections (UBI) in people with spinal cord injuries; the risk factors and diagnostic studies that should be done; indications for antibiotic use; appropriate follow-up management; and needed future research (with education and training issues covered on page 24). Urinary tract infection was defined as bacteriuria with tissue invasion and resultant tissue response with signs and/or symptoms. Risk factors were found to include: over-distention of bladder, vesicoureteral reflux, high pressure voiding, large post-void residuals, presence of stones in urinary tract, and outlet obstruction. Possible physiologic/structural, behavioral, and demographic risk factors were identified also. Indwelling catheterization, including suprapubic and urinary diversion are the drainage methods most likely to lead to persistent bacteriuria. Infection risk is found to be reduced with intermittent catheterization, but people with more severe disabilities who require catheterization by others are at greater risk for UTIs. Clean self-intermittent catheterization does not pose a greater risk of infection than sterile self-intermittent catheterization and is much more economical. Criteria for the diagnosis of UBI is discussed and symptomatic UBI is recommended to be treated with antibiotics for 7-14 days. (Author/CR)



The Prevention and Management of Urinary Tract Infection Among People With Spinal Cord Injuries

CONSENSUS STATEMENT

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The National Institute on Disability and Rehabilitation Research (NIDRR) Consensus Validation Conferences are convened to evaluate and synthesize available scientific information and improve the dissemination of findings from rehabilitation research. It is anticipated that practices discussed in this statement will be adopted by practitioners and consumers.

NIDRR Consensus Statements are prepared by a non-federal, 10-member panel, based on (1) resource papers prepared by experts; (2) testimony presented by researchers, clinicians, and consumers during a one-day public hearing; and (3) a day of closed deliberations by the panel during which the consensus statements are prepared. This statement is an independent report of the panel and is not a policy statement of NIDRR or the Federal Government.

Copies of this statement are available from:

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Abstract

The Urinary Tract Infection Consensus Conference brought together researchers, clinicians, and consumers to arrive at consensus on the best practices for preventing and treating urinary tract infections in people with spinal cord injuries; the risk factors and diagnostic studies that should be done; indications for antibiotic use; appropriate follow-up management; and needed future research. Urinary tract infection was defined as bacteriuria ($\geq 10^2$ bacteria/ml of urine) with tissue invasion and resultant tissue response with signs and/or symptoms. Asymptomatic bacteriuria represents colonization of the urinary tract without symptoms or signs.

Risk factors include: over-distension of bladder, vesicoureteral reflux, high pressure voiding, large post-void residuals, presence of stones in urinary tract, and outlet obstruction. Possible physiologic/structural, behavioral, and demographic risk factors were identified also. Indwelling catheterization, including suprapubic, and urinary diversion are the drainage methods most likely to lead to persistent bacteriuria. Infection risk is reduced with intermittent catheterization, but more severely disabled people who require catheterization by others are at greater risk for UTIs. Clean self-intermittent catheterization does not pose a greater risk of infection than sterile self-intermittent catheterization and is much more economic. However, care must be given to proper cleansing of reusable catheters.

Quantitative urine-culture criteria for the diagnosis of bacteriuria include: catheter specimens from individuals on intermittent catheterization - $\geq 10^2$ cfu/ml; clean-void specimens from catheter-free males using condom collection devices - $\geq 10^4$ cfu/ml; specimens from indwelling catheters - any detectable concentration. Dip stick screening tests may offer promise as an early warning system of UTI since they can be self administered.

Symptomatic UTI should be treated with antibiotics for 7 - 14 days. Longer courses have not been beneficial. In patients with symptomatic UTIs, it is not necessary to wait for the results of cultures before starting treatment. Asymptomatic bacteriuria need not be treated with antibiotics. There is little evidence presently to support the use of antibiotics to prevent infections.

Following a recent episode of febrile UTI, possible contributing prior events should be reviewed. The upper tracts should be evaluated (imaging studies) to identify possible abnormalities. A common concern among people with spinal cord injuries is that physicians will alter bladder management programs without regard to lifestyle needs. Social/vocational flexibility may be more important to them than a state-of-the-art bladder management program.

Future research should focus on obtaining more representative samples and investigate psycho-social-vocational implications as well as additional clinical-medical factors.

Introduction

Recent estimates suggest that about 200,000 Americans live with the sequelae of spinal cord injuries, and that about 8,000 new individuals sustain spinal cord injuries each year. Motor vehicle accidents, gunshot wounds and other violence, and falls are the three main causes of these injuries. More than 80 percent of spinal cord injured people are males, and they are predominantly young.

Before World War II, spinal cord injured individuals simply did not survive. Virtually all succumbed to urinary tract complications within a very short time. As a result of the massive numbers of spinal cord injuries incurred during wartime, medical science sought ways to resolve fatal urinary tract infections and related complications. The introduction of antibiotics drastically changed medical care, and the life expectancy of people with spinal cord injuries now approaches normal.

However, urinary tract infections (UTIs) continue to pose a threat to the survival and quality of life of people with spinal cord injuries. Untreated, UTIs still take lives. Treated too late or incorrectly, they produce frequent illness and malaise that interfere with all aspects of daily living.

The Model Spinal Cord Injury systems funded by The National Institute on Disability and Rehabilitation Research (NIDRR) began in 1970. During the 22-year history of this program, research aimed toward improved treatment and management of spinal cord injury and its associated disorders and complications has yielded valuable scientific evidence contributing to the following outcomes:

- improved mortality rates,
- lowered morbidity rates,
- reduced hospitalization costs,
- improved overall health for people with spinal cord injuries, and
- greater opportunity for participation in the full range of personal and community activity.

Most people who sustain spinal cord injuries are active as workers (60 percent) or as students (20 percent) at the time they are injured. It is important that they continue to lead active, productive lives since this has been shown to correlate with higher levels of general health. A challenge to continuing health and active lifestyle is posed by the fact that people with spinal cord injuries usually have neurogenic bladder dysfunction and this is associated with a very high likelihood of frequent urinary tract infections (UTIs).

The purpose of the UTI Consensus Validation Conference is to close the gap between research and clinical practice in urinary tract infection prevention, treatment, and management. Knowledge advances have occurred that are still unknown in the practice community; and information needed by people in the field of practice has not yet been addressed by research. Consensus Validation provides avenues toward the solution of both problems by clarifying the state of the art — for dissemination to the field and to reveal what additional research is needed. Problems affecting work and community living are emphasized, and their resolution is facilitated by clearly distinguishing what is known from what is not yet known.

The Consensus Validation Conference operates in the mode of a Court of Science. The Conference questions constitute the charge to a "jury" of experts. The Consensus Panel comprises the "jury." The testimony provided by speakers with various kinds of expertise — e. g., professional and consumer viewpoints — constitutes the "evidence." The Panel weighs the evidence and reaches a consensual "verdict," which is published and widely disseminated. However, unlike a typical court model, the audience is encouraged to ask questions, make comments, and provide further evidence.

The UTI Consensus Validation Conference brought together the varied expertise of researchers, clinicians, and consumers in an effort to arrive at consensus on the best practices known today for preventing and correcting urinary tract infections among people with spinal cord injuries. Following the expert presentations, the UTI Consensus Panel deliberated for a full day to synthesize the testimony with information in the research papers commissioned for the Panel's use in order to answer the following six questions:

1. What are appropriate definitions of significant bacteriuria and urinary tract infection as applied to people with spinal cord injuries?

2. What risk factors (structural, physiological, behavioral, demographic) predispose people with spinal cord injuries to urinary tract infection? How are these risk factors further influenced by methods of urinary drainage?

3. What diagnostic studies should be done when people with spinal cord injuries present symptoms of urinary tract infections to confirm this diagnosis and make treatment and management decisions? What are the indications for hospitalization?

4. What are the appropriate indications for antibiotic use for urinary tract infection with people who have spinal cord injuries? Are indications altered by duration of injury, treatment, setting, or method of urinary drainage? When antibiotics are used, what factors influence choice of drugs, dosage, duration, and route? Are there indications for long-term use of prophylactic antimicrobial agents?

5. What is appropriate follow-up management for people with spinal cord injuries who have had urinary tract infections?

6. What is the needed direction for future research?

What are appropriate definitions of significant bacteriuria and urinary tract infection as applied to people with spinal cord injuries?

Urine from the kidney and urinary bladder is normally sterile. Thus, the presence of bacterial growth in the urine represents a departure from normal. In the past, a urinary tract infection (UTI) has been defined as the presence of $\geq 10^5$ colony forming units per milliliter (cfu/ml) of urine. However, a colony count only describes bacteriuria rather than actual infection, since infection implies some degree of tissue invasion or reaction to the bacteria.

There are instances when the bacterial count is less than 10^5 and the urinary system must still be regarded as inhabited by microorganisms. Whether this should be considered simply colonization or actual infection depends in part on the host response, the method of specimen collection, and present or recent treatment. Bacteria virulence may also influence the likelihood of infection.

Since a UTI implies bacteriuria with tissue invasion, signs and symptoms result. They may include one or more of the following:

- leukocytes in the urine generated by the mucosal lining;
- discomfort or pain over the kidney or bladder, or during urination;
- onset of urinary incontinence;
- fever;
- increased spasticity;
- autonomic hyperreflexia;
- cloudy urine with increased odor, or
- malaise, lethargy, or sense of unease.

Asymptomatic bacteriuria therefore assumes the absence of the above findings.

In an attempt to quantify the urinary system's response to the presence of microorganisms, the production of white blood cells, usually leukocytes, has been determined. Some evidence indicates that if 10 or more white blood cells are present in a centrifuged urine sample per high power microscopic field (400x), urinary infection is present. The accuracy of this simple method has been challenged and, consequently, white blood cell counts have been determined using a counting chamber. In an unspun sample, 10 or more white blood cells per ml seems to correlate with infection, or at least 10^5 or greater bacteria. The presence of white blood cells in the urine may also be determined by a dip stick method in which the leukocyte esterase produces a color change.

In summary, any microorganism in the urinary tract may be considered an abnormality. Even numbers less than 10^5 must be considered abnormal, not being present under normal conditions. Evidence of the body's response to the organism, such as fever, pain, and the presence of white blood cells in the urine, indicates the infectious nature of the organism. Labeling the presence of bacteriuria as an infection requires a clinical appraisal of the patient's symptoms, physical findings, as well as method of urinary drainage.

For the purpose of this publication, we are defining the following terms:

- Urinary tract infection is bacteriuria with tissue invasion and resultant tissue response with signs and/or symptoms.

- Asymptomatic bacteriuria represents colonization of the urinary tract with no reference to symptoms or signs.

Infections may range from mild to life-threatening. The clinical diagnoses and determination of when to treat will be discussed in the following sections of this paper.

What risk factors (structural, physiological, behavioral, demographic) predispose people with spinal cord injuries to urinary tract infection?

Risk factors associated with the development of urinary tract infection after spinal cord injury may be broadly divided into categories related to the function and anatomy of the urinary tract (such as outlet obstruction), the health of the individual at risk, and other sociological and demographic characteristics.

Structural and physiological risk factors that predispose people with spinal cord injuries to UTIs are generally more widely researched and acknowledged. The following lists indicate which factors have been generally accepted and those that are implicated but have not been sufficiently researched.

Generally Accepted Risk Factors:

- over-distention of bladder,
- vesicoureteral reflux,
- high pressure voiding,
- large post-void residuals,
- presence of stones in urinary tract, and
- outlet obstruction (e.g., detrusor-sphincter dyssynergia, urethral strictures, enlarged prostate).

Additional risk factors not as widely understood or researched fit mainly into behavioral and demographic categories. Research and documentation is lacking and will need to be undertaken to relate the impact of these factors for people with spinal cord injuries and urinary tract infections. Avoiding and minimizing these risk factors may help in the prevention of urinary tract infections.

Possible Physiologic or Structural Risk Factors:

- inadequate fluid intake (hydration may be affected by unanticipated circumstances; e.g., acute illness, diarrhea, high temperature),
- reduced host defenses; e.g., chronic pressure sores, debilitating systemic diseases, extreme fatigue, anemia, decreased protein stores, and nutrition,

- pregnancy,
- repeated traumatic urethral catheterizations,
- pre-existing structural anomalies of the collecting system, and
- functional levels; e.g., Frankel level (studies suggest an association with reduced function and incidence of UTI).

Possible Behavioral Risk Factors:

- knowledge of the urinary system (the level of understanding of spinal cord injured people and health care professionals is critical to urinary tract management),
- level of acknowledgment of functional limitations on the individual's life (adjustment),
- poor personal hygiene (lack of perineal hygiene may spread microorganisms into the urinary system),
- eating habits (controlled or uncontrolled factors leading to inappropriate eating habits and poor health),
- inactivity,
- self-esteem (low self-esteem may lead to self-imposed isolation and apathy towards self-care and management),
- life satisfaction,
- health care insurance coverage, and
- work or productivity (full- or part-time work, volunteering, parenting, home and attendant management, and entrepreneurial, avocational, and leisure-time activities).

Possible Demographic Risk Factors:

- social support systems (lack of psychological or social systems support inclusive of family and friends),
- social interaction (lack of opportunities to participate in social and community interactions may affect motivation and health status),
- age (a person who acquires a spinal cord injury at an older age may be affected additionally by age-related conditions such as benign prostatic hypertrophy, which may impact the urinary system),
- gender (affects choice of bladder management),
- residence location (may affect access to health care information and the delivery system), and
- access to services (transportation, attendant care, public accessibility).

How are these risk factors further influenced by methods of urinary drainage?

I. Indwelling Catheterization:

Of the various methods of urinary drainage, the methods most likely to lead to persistent bacteriuria are:

1) indwelling catheterization including suprapubic catheters, and
2) urinary diversion; e.g., ileal or colonic conduit.

Ascending urinary tract infection with indwelling Foley catheters has been well documented. Studies have shown that epididymitis, peno-scrotal abscess, urethral strictures, fistula, and renal and bladder stones are more common using indwelling catheters than with intermittent catheterization.

II. Intermittent Catheterization:

Although the risk of infection is reduced with intermittent catheterization, people with spinal cord injuries and health professionals need to apply proper management of intermittent catheterization, including proper follow up. People with spinal cord injuries unable to perform self-intermittent catheterization and who need to be catheterized by others are at greater risk of developing UTIs for a variety of reasons, including the difficulty of maintaining adequate catheterization schedules.

Women with spinal cord injuries may find it difficult to utilize intermittent self-catheterization due to physiological differences. Success with this method may require additional proper pharmacologic (e.g., anticholinergic) or other interventions.

Intermittent self-catheterization is not always associated with low risk for UTIs. For example, this method, in the face of a high-pressure bladder system associated with detrusor-sphincter dyssynergia, may result in a greater frequency of UTIs and potential renal deterioration.

The technique of clean self-intermittent catheterization does not pose a greater risk of infection than sterile self-intermittent catheterization and is much more economic. Care must be given, however, to proper cleansing of reusable catheters.

III. Voiding With an External Collector:

Voiding with an external collector usually refers to the male patient using a condom collection system. The presence of a condom collection system indicates incontinence but does not explain its cause and may reflect reflex voiding or overflow incontinence. Although the condom catheter has been associated with penile and urethral complications, little has been reported regarding the incidence of UTI. The condom catheter itself, in addition to the tubing and bags, can be a source of microorganisms leading to bacteriuria. Thus, proper cleansing techniques are important.

An external sphincterotomy and/or bladder neck resection may be recommended in some males with recurrent symptomatic infections. Although the reported incidence of UTI is reduced after sphincterotomy, a number of people may continue to have high post-void residuals secondary to failure to maintain a sustained bladder contraction.

IV. Voiding Without an External Collector:

Spinal cord injured people who do not use a catheter but do void with techniques such as suprapubic tapping, or with Crede, should not experience an increase in the risk of UTIs unless the technique or procedure is inappropriate. If there is recurrent UTI, reassessment of bladder management would be recommended. The small percentage of spinal cord injured people who void normally following an incomplete spinal cord lesion would not expect a greater incidence of UTIs than in the general population, nor would treatment strategies differ.

It is important to keep in mind that the neuropathic bladder undergoes physiological changes over time in spinal cord injured people, particularly in the first year or two after the injury. Systems of drainage may also change in a particular individual over the course of a lifetime for a variety of reasons.

What diagnostic studies should be done when people with Spinal Cord Injury present symptoms of urinary tract infection to confirm the presence of infection and make treatment and management decisions?

Confirmative Bacteriuria

Quantitative urine cultures are used to identify individuals in whom bladder urine is not sterile; i.e., those who have bacteriuria. Consensus criteria for the diagnosis of bacteriuria — which may or may not be symptomatic or need treatment — vary according to the method of urinary drainage and the method of specimen collection. For people with spinal cord injuries, quantitative urine-culture criteria that have optimal sensitivity and specificity for the diagnosis of bacteriuria include:

- catheter specimens from individuals on intermittent catheterization: $\geq 10^2$ cfu/ml.;
- clean-void specimens from catheter-free males using condom collection devices: $\geq 10^4$ cfu/ml (In this group, cultures yielding between 10^2 and 10^4 cfu/ml are equivocal);
- specimens from indwelling catheters: any detectable concentration; and
- suprapubic aspirates: any detectable concentration.

It should be noted that for these four groups of people with spinal cord injuries, the traditional criterion of $\geq 10^5$ cfu/ml has unacceptable low sensitivity for most clinical, epidemiologic, or research purposes. In people with spinal cord injuries, urine cultures yielding coagulase-negative staphylococci, or multiple organisms with the above-noted colony counts, contamination cannot be assumed. Full identification and sensitivity testing of such isolates may be necessary for clinical or infection-control purposes.

Evaluating Pyuria

Tests for pyuria (pus cells in urine) have been advocated by some as a method of identifying bacteriuric individuals who require treatment. However, no data currently exists to support the efficacy of this approach in asymptomatic individuals, although it is intuitively appealing to use pyuria as an indication of inflammation and/or invasive infection.

- The most commonly used method of estimating pyuria, enumeration of leukocytes per high power field in centrifuged urine, is poorly reproducible and does not reliably correlate either with the leukocyte excretion rate or with the recommended method, enumeration of leukocytes in uncentrifuged urine (cells/mm^3) using a hemocytometer chamber.

- Abnormal levels of pyuria (>10 cells/mm^3) are present in the great majority of people with spinal cord injuries who have indwelling catheters and also those using intermittent catheterization.

- In people using intermittent catheterization, catheter urine is inhomogeneous and leukocyte counts are significantly higher in terminal catheter urine than in mid-catheter specimens or suprapubic aspirates.

- Absence of pyuria is a good predictor of absence of high-level gram-negative bacteriuria, but pyuria may be present in the absence of bacteriuria.

Localizing Infection

Methods of localizing the site of infection, or of differentiating between invasive and non-invasive infections, would be of great value to people with spinal cord injuries, in view of a) the high prevalence of asymptomatic bacteriuria; b) the association between bacteriuria and important morbidity and mortality in some cases; and c) the disadvantages of routine antimicrobial therapy for all episodes of asymptomatic bacteriuria. Uretheral catheterization is the gold-standard method of localization, but is not suitable for routine clinical use or for use in large-scale treatment studies. The [illegible] r washout test correlates poorly with results of uretheral

catheterization in people with spinal cord injuries. The possibility that it may be useful for distinguishing invasive from non-invasive infections may merit further study. The antibody coated bacteria test correlates poorly with results of both uretheral catheterization and bladder washout tests in this population. It does not successfully predict outcome of antibiotic treatment of UTI in people with spinal cord injuries. At present, no other non-invasive or indirect tests of localization or invasiveness are sufficiently sensitive and specific to be useful in the clinical arena.

Diagnostic Studies in People With High Fevers

When spinal cord injured people have high fever, rigors, or other signs of severe systemic infection, diagnostic studies need only to confirm the presence of bacteriuria before starting treatment, assuming all other potential sources for systemic infection have been ruled out. A catheter-obtained urine sample should be obtained to relieve bladder distension and rule out stricture; and permit a microscopic examination that can give an indication of bacterial group for guiding initial choice of antibiotic. There are no guidelines based on scientific studies to confirm the relationship between bacteriuria and the signs of systemic illness, although retrospectively determined quantitative counts of $>10^5$ are most often used. Urine samples should always be obtained for laboratory identification of bacterial species and antibiotic sensitivity testing before antibiotic treatment. Blood cultures should be performed to confirm possible bacteremia.

Since febrile symptomatic UTIs are often localized in the upper urinary tract, diagnostic studies to determine an anatomic cause for infection, such as hydronephrosis, vesicoureteral reflux, or collecting-system stones, should be considered. A renal ultrasound is a simple and safe screening test for renal abscess or hydronephrosis. A kidney-uretha-bladder x-ray can screen for any collecting-system stones. If there is any question of a stone seen on a plain abdominal radiograph or a question of hydronephrosis, then intravenous pyelography is indicated for better visualization of the ureters. If the kidneys are poorly visualized by ultrasound or if there is a strong suspicion of a

renal, perirenal, or retroperitoneal abscess, computerized tomography may be done. The advantages of ultrasound are that it is non-invasive and easy to obtain. The disadvantage is that it is technique dependent, so results may vary and it is sometimes difficult to visualize the kidneys, especially in someone who is obese.

Instrumentation during an acute febrile infection should be minimized; therefore, cystogram, urodynamics and cystoscopy when indicated are best deferred until the person's condition has stabilized.

Patient/Physician Partnerships in Diagnostic Evaluations

As people with spinal cord injuries manage their medical conditions, they learn to detect changes in the smell or appearance of their urine, more than usual amounts of fatigue, feet swelling, temperature intolerance, back pain, chills and fever, difficulty in forcing fluids, and often, a unique combination of symptoms.

The interdependence of the treating physician and the person with a spinal cord injury becomes obvious when results of laboratory tests are reviewed. Laboratory findings, in isolation, do not define treatment. The person with a spinal cord injury is most familiar with the symptoms of infection. Over time, people with spinal cord injuries can learn to make precise observations that facilitate appropriate management decisions. The unique history of every person is essential for individualizing treatment. Treating physicians are responsible for listening and valuing the information provided by the person with a spinal cord injury. The person, in turn, is responsible for explaining symptoms and knowing his or her own medical history.

The recent development of dip stick screening tests for bacteriuria and pyuria offer promise as an early warning system of UTI for people with spinal cord injuries, since they can be self-administered. They offer sufficient sensitivity and specificity to be used as a screen in deciding to obtain more accurate quantitative culture and sensitivity testing. Use of this technique can contribute to a good patient-physician partnership while providing a convenient and cost-effective diagnostic technique.

Shared decision-making is the goal in the management of UTI. Such issues as the intensity of antibiotic treatment and possible consequences (e.g., resistant organisms, chronic debilitation) must be considered. The person with a spinal cord injury must be informed and active in the decision-making process, whether those decisions relate to further diagnostic procedures or management strategies. Unless a partnership exists, consent cannot be considered informed.

What are the indications for hospitalization?

Severity-of-illness indications for hospitalization of people with spinal cord injuries who have UTIs include high fever, chills/rigors, systemic signs of sepsis or dehydration, and nausea/vomiting that jeopardize adequate hydration. Intensity-of-services indications include the need for parenteral fluid therapy or parenteral antibiotics. Hospitalization should be continued until the person's condition can be safely managed on an out-patient basis and indicated invasive testing has been completed.

What are the appropriate indications for antibiotic use for urinary tract infection with people who have spinal cord injuries?

Symptomatic urinary tract infection (as defined earlier) should be treated with antibiotics. Bacteriuria is verified by urine culture. Although there is no consensus as to the exact number of white blood cells, pyuria is sometimes used to guide treatment.

In the past, the presence of bacteriuria at various quantitative levels has been an indication for antibiotic treatment, but published studies have not shown that improved outcomes result from treatment of asymptomatic bacteriuria. Therefore, asymptomatic bacteriuria need not be routinely treated with antibiotics. However, the presence of urease-producing organisms that are associated with stone formation, such as Proteus species, may warrant antibiotic treatment.

Are indications altered by treatment setting or duration of injury?

Treatment settings include: 1) acute care, and rehabilitation facilities; 2) routine visits to outpatient clinics or physicians' offices; and 3) emergency visits to physicians or emergency rooms.

Many spinal cord injury treatment units differentiate asymptomatic bacteriuria in recently-injured, hospitalized people from those in whom asymptomatic bacteriuria is detected later — treating the former and not the latter. Factors that influence the decision to treat include recovery of bladder function after removal of an indwelling catheter, and traumatic urethral catheterization.

At the time of emergency visits to physicians, people with spinal cord injuries frequently have high fever and the results of urine culture are not available. Blood cultures should be obtained because of the possibility of bacteremia (bacteria in the blood). If patients have potential bacteremia, initial treatment should be with antibiotics in doses that achieve blood levels adequate to treat bacteremia.

Are indications for treatment altered by the method of urinary drainage?

Bacteriuria is expected with indwelling catheters. In addition, more than half of spinal cord injured people with urinary tract diversion; e.g., ileal loop, will have bacteriuria. Treatment in both instances should be based on the presence of symptoms.

When antibiotics are used, what factors influence choices of drugs, dosage, duration and route?

Because the bacteria causing urinary tract infections associated with spinal cord injuries tend to be resistant to antibiotics, obtaining a urine specimen to test the susceptibility of the bacteria to antibiotics is important before starting therapy. If the patient has a high fever and leukocytes (increased white cells in the blood), broader coverage with antibiotics is important until antibiotic susceptibility is known. The antibiotic treatment has frequently been intravenous aminoglycosides and ampicillin. If there is concern about renal function, the aminoglycoside may be replaced by a third generation cephalosporin or quinolone. These or other oral antibiotics to which the bacteria is susceptible have been used for 7-14 days. Longer courses of antibiotics have not been beneficial.

In patients with symptomatic urinary tract infections, it is not necessary to wait for the results of cultures before starting treatment.

Are there indications for long-term use of prophylatic or preventive agents?

The use of agents to prevent the development of bacteriuria has been studied using a range of drugs including sulfamethoxazole trimethoprim, mandelic acid, and macrocrystals.

These studies have shown reduction in bacteriuria, but there has been little effect on the symptoms of urinary tract infections. There is little evidence to support the use of preventive antibiotics at the present time.

Although commonly used, there are no studies showing benefit from the use of cranberry juice or ascorbic acid (Vitamin C) as prophylactic agents.

Outcomes

Treatment of urinary tract infections may result in cure (absence of bacteriuria), relapse or persistence of the infection (presence of same bacteria), or reinfection with new bacteria. Relapse, persistent infection, or reinfection may occur with or without symptoms.

A person with asymptomatic bacteriuria need not be treated. Those with symptoms and bacteriuria persisting after taking a course of antibiotics should be retreated for 7-14 days. Longer courses of antibiotics have not been beneficial.

What is appropriate follow-up management for people with spinal cord injuries who have had urinary tract infections?

Appropriate follow-up management for people with spinal cord injuries who have had urinary tract infections is dependent on a number of medical and personal choice factors. The primary medical factors depend on whether there is a high fever, severity of other symptoms, and frequency of previous infections. All decisions need to be made with the spinal cord injured person as an active member of the decision-making process.

The following discussion is based on people undergoing routine urologic follow-up who had been doing well up to the time of the urinary tract infection.

Symptomatic Urinary Tract Infection - With a High Fever

There is a strong consensus regarding appropriate follow-up management of people with spinal cord injuries who have had high fevers due to urinary tract infections. Following the recent episode of a febrile UTI, initial follow-up should begin with a review of events prior to the episode that may have contributed to the development of the UTI; e.g., dehydration, bladder distension from clogging of a Foley catheter with stones/debris, increased interval between intermittent catheterization, or skipping doses of medications to relax the bladder or the external sphincter.

Spinal cord injured people with high fevers need an evaluation of the upper tracts (kidneys and ureters) to identify possible obstruction, stones, or other abnormalities. If imaging studies of the upper tracts (such as an ultrasound, renal scan, possible intravenous pyelogram) were not done in the hospital, they should be done on follow-up. Instrumentation of the urinary tract should be deferred if possible while the patient is acutely septic.

Further diagnostic work-up after response to antibiotics is indicated. A cystogram can rule out vesicoureteral reflux. Urodynamics can identify elevated voiding pressures, poor

bladder compliance, inefficient bladder emptying in those with reflex voiding, and uninhibited bladder contractions with high intravesical pressures in those using intermittent catheterization. Any of these problems can cause poor drainage from the kidneys with an increased chance of upper tract involvement. Cystoscopy may be used for evaluating the anatomy of the urethra, sphincter mechanism, prostate and bladder outlet for the presence of small eggshell calculi that may not be seen on plain abdominal radiographs.

Symptomatic Urinary Tract Infection - Without a High Fever

There is less consensus regarding the need for follow-up diagnostic studies on people with symptomatic urinary tract infections in which there has been no fever. There are a number of reasons for the lack of consensus, including the wide spectrum of type and severity of symptoms, as well as frequency of reported recurrence of symptomatic infections. Additionally, there is less concern that the upper tract was involved if there was no fever.

If recurrent, symptomatic UTIs significantly affect a person's lifestyle, further diagnostic work-up is recommended. It should focus on the lower urinary tract. A urodynamic evaluation can characterize bladder filling and voiding abnormalities and suggest strategies that may decrease the incidence of further symptomatic infections. Cystoscopy may be helpful for evaluation for anatomic problems such as urethral or bladder diverticuli and bladder stones. A plain abdominal radiograph with tomograms can often identify bladder and kidney stones. This should particularly be done when a stone forming organism (such as Proteus species) has been identified.

Follow-up Management

Follow-up management of symptomatic infections depends on what is identified on work-up. Additionally, personal choice factors of the person with spinal cord injury are important in management. The input from people with spinal cord injuries is vitally important in two respects. The person must understand the purpose of the procedure before it can be carried out. The purpose of the follow-up procedure is to determine if changes in health maintenance behaviors are indicated. A physician must understand from the

consumer's perspective how well the present bladder management procedure is working. Ultimately, follow-up tests are not likely to be productive if the person with a spinal cord injury has no intention of changing health care practices based on test results.

A common concern among people with spinal cord injuries is that physicians will change their type of bladder management program without regard to how proposed new techniques may adversely impact their lifestyles. People with spinal cord injuries generally place a high value on having an active social life or an engaging career. Many people with spinal cord injuries also have limited financial resources. From the person's perspective, having a bladder management program that allows them to be maximally involved socially and vocationally, or places the least strain on them financially, may be more important than having the state-of-the-art bladder management program. For example, intermittent catheterization may provide for better urinary drainage in a person with a C4 quadriplegia, but requires a much greater amount of personal assistance to carry out the technique appropriately. A person with a spinal cord injury should have the choice of risking a higher incidence of urinary tract infection, as opposed to carrying out a urinary drainage method that decreases social or vocational activity, adds significant financial expense, and increases overall dependence.

What is the needed direction for future research?

From review of the research papers and expert testimony, gaps and limitations in previous research are apparent:

1. Throughout the research literature on UTI among people with spinal cord injuries, different operational definitions of infection and other terms are used.

2. Samples are not composed of people with similar characteristics on relevant variables, such as urinary drainage methods used.

3. Study subjects tend to be drawn from available clinical samples. Therefore, there is little ability to generalize from the results to the wider populations of spinal cord injured people. Newly injured people and people with spinal cord injuries who are seen within particular service populations — such as the VA — tend to be over-represented, while those who have lived with spinal cord injuries for extended periods and those who are outside of established service delivery systems are under-represented.

4. Most research subjects have been males. Diagnostic and management principles for females tend to be extrapolated from data on males, which is often inappropriate.

The preceding consensus statement must be considered in the light of these research factors that limit data comparisons and generalizations. Current best practice has been described, utilizing research that is incomplete. The state of the art in prevention and management of UTI among people with spinal cord injuries is based on a combination of limited research information and repeated clinical observations. The challenge for a National Institute on Disability and Rehabilitation Research (NIDRR) research program is to link researchers, interdisciplinary practitioners, and people with spinal cord injuries, asking questions that will lead to useful information for both practitioners and people with spinal cord injuries. Broad-based, longitudinal studies, including both male and

female subjects, using uniform measures, should produce generalizable results. The need for quality research is urgent, as people with spinal cord injuries are now living long, productive lives in communities across the United States, despite the fact that UTIs remain common.

Additional research is needed in a number of categories.

Education and Training Issues

Research is needed to:

1. identify the best methods for teaching people with spinal cord injuries to observe, monitor, and respond quickly to their bodies' prodromal warning signs that urinary tract infections may be developing;

2. determine strategies to integrate the expertise of the professional and the experienced person with a spinal cord injury to improve bladder management techniques and reduce medical complications of the neurogenic bladder;

3. assess the impact of peer counseling on management of the neurogenic bladder and on reducing the incidence of UTIs;

4. determine effective strategies to provide holistic information to interdisciplinary health professionals with an emphasis on enhancing consumer choices and responsibilities to promote desired outcomes; and

5. identify critical factors and establish practice parameters for physicians treating UTIs among people with spinal cord injuries. These parameters must include patient-physician relationship factors, as well as medical knowledge and skill factors.

Psycho-Social Issues

Research is needed to determine:

1. changes in bladder system function over time after onset of spinal cord injury. This should include both the effects of age at onset and the elapsed time since onset;

2. the extent to which esthetic issues influence adherence to bladder management techniques that minimize UTIs;

3. the advantages and disadvantages of various bladder management methods on fertility and sexual pleasure;

4. which strategies facilitate accommodation to spinal cord injured people and their independent function; which strategies reduce the burden to caregivers; which strategies are more emotionally acceptable to those in the older generation; and

5. the relationship between health status and degree of involvement in normal life activities. Support needs to be obtained for the hypothesis that well being and attitude toward life have an important impact on the frequency and severity of UTIs in people with spinal cord injuries.

Lifestyle Issues

Research is needed to determine:

1. whether activity levels of people with spinal cord injuries change the frequency of infection; e.g., whether, given equal levels of bacteriuria, more active people become less debilitated during these occurrences; and

2. differences in the ways people with spinal cord injuries in rural areas manage urinary tract infections compared with those in metropolitan areas.

Clinical Research: Antibiotics

Research is needed to:

1. determine if treatment of asymptomatic bacteriuria or prophylaxis reduces morbidity (including fever, bladder function abnormalities, calculi, epididymitis, renal changes), improves patient well-being, or leads to fewer visits to clinics and hospitals;

2. develop tests to determine tissue invasion; e.g., antibodies, C-reactive protein, or interleukin-6;

3. determine whether any bacterial species or strains are more or less virulent; i.e., urease producers;

4. determine the results of treatment of symptomatic and asymptomatic infection more than six months after injury;

5. determine if acidification or other methods, such as irrigation, prevent calculi or other complications of indwelling catheters;

6. determine whether immunization against various established microorganisms has potential;

7. determine whether an increase in the length of antibiotic medication would reduce the risk of reoccurrence; and

8. identify predictors of bacterial invasion in people with spinal cord injuries.

Age-Related Issues

Research is needed to:

1. compare the suitability of bladder management strategies for people whose spinal cord injuries occur later in life;

2. investigate the relationship between the age of people with spinal cord injuries and psychosocial consequences of the various strategies to manage the neurogenic bladder. For example, which strategies permit children with spinal cord injuries to develop social skills without the hindrance of an unwieldy activities-of-daily-living program? Which strategies permit children to have maximum flexibility and freedom to live a normal life, develop the skills needed for successful adult social and vocational endeavors and reduce the burden on caregivers?

3. determine the psychosocial impact of a neurogenic bladder in childhood and the impact of incontinence on social skills development, on the emotional response of the child to the disability, and on family stress.

Women's Issues

Research is needed to:

1. determine methods to prevent leakage of urine in women;

2. identify ways in which optimal bladder management may differ between women and men;

3. study the use of intermittent catheterization in women to determine its medical and social advantages/disadvantages as well as its cost/benefit ratio; and

4. promote the development of new products (such as catheter coatings) that may minimize UTIs.

Medical Issues

Research is needed to:

1. evaluate treatment with antibiotics, surgical procedures and various methods of bladder drainage through long-term follow-up studies;

2. determine the frequency of incontinence across various types of bladder management;

3. determine whether sphincterotomy increases longevity and reduces morbidity;

4. evaluate effectiveness of new alternative methods (stents, balloon dilation, etc.) to surgical sphincterotomy;

5. study the effects of using the bowel to augment bladder function and the long-term implications on carcinoma of the bladder. Determine whether these operations preserve upper urinary tract function; and

6. further investigate the relationships between bladder pressure and risk of UTI.

Quality of Life Issues

Research is needed to:

1. compare UTI methods across the lifetime of spinal cord injured people for the prevention of future problems and increasing longevity;

2. study the impact of bladder management procedures on the quality of life of people with spinal cord injuries; and

3. compare with traditional methods the effectiveness of functional electrical stimulation for bladder emptying and continence.

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