Published in final edited form as:
Curr Opin Infect Dis. 2010 February ; 23(1): 76–82. doi:10.1097/QCO.0b013e328334dda8.

Management of Catheter-Associated Urinary Tract Infection (CAUTI)

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Abstract

Purpose of Review—The aim of this article is to review recent publications concerning the management of catheter-associated urinary tract infection, including the issues of diagnosis and prevention. Articles reviewed include the various guidelines concerning CAUTI released recently by multiple organizations.

Recent Findings—There has been a recent upsurge of interest in prevention of CAUTI and a proliferation of guidelines in this area. Social changes in US government reimbursement to hospitals and public reporting of hospital-acquired infections may underlie this interest. The awareness that CAUTI and catheter-associated asymptomatic bacteriuria (CA-ASB) are distinct conditions is increasing, but unnecessary treatment of ASB remains quite prevalent. The focus in recent CAUTI literature is on prevention, often through strategies to minimize urinary catheter use. Very little new evidence is available to guide diagnosis and treatment strategies.

Summary—Interpretation of many studies of CAUTI is impeded by the failure to distinguish between symptomatic CAUTI and ASB in the study outcomes. This distinction currently relies on clinical symptoms and is not easily made, even with the help of various guidelines. Many aspects of the management of CAUTI merit further study, and the current interest in CAUTI is likely to lead to exciting advances in this field.

Keywords

Urinary catheter; urinary tract infection; asymptomatic bacteriuria; catheter-associated urinary tract infection

Introduction

Urinary tract infection (UTI) is the single most common hospital-acquired infection, and the majority of cases of nosocomial UTI are associated with an indwelling urinary catheter.[1–2] Catheter-associated urinary tract infection (CAUTI) had been relatively neglected in clinical research until recently[3**]. However, external forces, such as mandated public reporting of nosocomial infections and the climate of “zero tolerance” for hospital-acquired infections have led to an increased interest in this infection [4*, 5**, 6]. Multiple institutions have released or will soon release guidelines concerning CAUTI [7*, 8*, 9*, 10**, 11**]

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The author is not aware of any conflicts of interest related to this manuscript.

and the related but distinct condition of catheter-associated asymptomatic bacteriuria (CA-ASB)[12**–13].

The greatest common strength of the guidelines relates to strategies to avoid unnecessary catheterization and to remove urinary catheters that are no longer necessary. Another area which emerges with particular strength is increased awareness that CAUTI and ASB are distinct conditions and should be treated (or not) accordingly. However, the guidelines can only be as good as the quality of the evidence; another service that these expert reviews have provided is identifying gaps in our understanding of CAUTI and where the evidence from clinical trials falls short. For example, many of the clinical trials concerning use of antimicrobial catheters for prevention of CAUTI are limited by poor study design or by a failure to understand the difference between CAUTI and ASB [14]. Few if any recent clinical studies have addressed the symptoms and signs that distinguish CAUTI from ASB or the actual management of CAUTI when it does arise.

Guidelines and Definitions Concerning CAUTI

The following discussion is intended to provide a helpful overview of some of the guidelines published during the past 18 months. Three sets of guidelines provide facility-based recommendations for the prevention of CAUTI: the Society for Healthcare Epidemiology of America (SHEA)/Infectious Diseases Society of America (IDSA) 2008 recommendations for acute care hospitals [8*], the Association for Professionals in Infection Control and Epidemiology (APIC) 2008 Guide for acute and long-term care settings [7*], and the Centers for Disease Control (CDC) 2008 Draft Guideline for any type of health care setting. The SHEA/IDSA recommendations concerning CAUTI are a chapter from the Compendium of Strategies to Prevent Healthcare-Associated Infections in Acute Care Hospitals [11**], created under the collaborative leadership of experts from SHEA, IDSA, APIC, the joint commission, and the American Hospital Association (AHA). This compendium was assembled from *previously published* hospital-acquired infection (HAI) prevention guidelines. The emphasis and perspective of these 3documents is on infection control at the hospital level. SHEA/APIC also published a joint statement concerning infection prevention and control in long-term care facilities that addresses CAUTI [9*].

Two sets of European guidelines have been released: the epic2 updated national guidelines for preventing HAI in National Health Service (NHS) hospitals in England [15], and the European and Asian guidelines produced by the International Society of Chemotherapy (ISC) working group on UTI in cooperation with the European Association of Urology [10**]. The emphasis of epic2 is to provide useful clinical advice for all hospital practitioners, while the ISC guidelines are directed towards urology departments and address CAUTI both inpatients and outpatients. The latter guidelines are also unique in their focus on management of CAUTI in addition to prevention.

The IDSA guidelines on CAUTI, which are scheduled for release later in 2009, will address the diagnosis, prevention, and treatment of CAUTI from the perspective of the clinical practitioner and the patient. Based on the overview provided at the annual IDSA meeting in 2008, these guidelines are likely to trigger some controversy. For example, the threshold of bacteriuria proposed at IDSA to diagnose CAUTI in a symptomatic patient was $\geq 10^3$ count-forming units (CFU)/ml. Also, the IDSA stance on pyuria was that the presence, absence, or degree of pyuria should not be used to differentiate CAUTI from CA-ASB. Both of these recommendations, if included in the final document, will be at variance with the updated CDC/National Healthcare Safety Network (NHSN) surveillance definitions of UTI. However, the IDSA emphasis is on enabling the clinician to detect a CAUTI in an individual

patient, while the CDC/NHSN definitions are intended for infection control surveillance purposes.

Many clinical practitioners and even some infection control personnel may not be aware of the 2009revised CDC definitions concerning UTI, for the initial publication of the updated CDC surveillance definitions for hospital-acquired infections (HAIs) in June 2008did not include UTI [16*]. The UTI criteria became effective in January2009and now exist online as an addendum to this publication [17**]. These updated definitions removed ASB from the UTI surveillance definitions and refined the criteria for symptomatic CAUTI to include symptoms plus a positive urine culture of $\geq 10^5$ CFU/ml or symptoms plus a positive urine culture of between$\geq 10^3$ and $\leq 10^5$ CFU/ml AND the presence of a positive urinalysis (as defined by a positive dipstick, pyuria, or microorganisms on Gram stain). In other words, if the level of bacteriuria is between $\geq 10^3$ and $\leq 10^5$ CFU/ml, a positive urinalysis is required to satisfy the diagnosis of CAUTI. The urinalysis criteria were included to improve the likelihood that lower levels of bacteriuria represent true infection (Gould CV, personal communication).

An important point to be aware of when reading these various guidelines and definitions is that they all generally draw from the same pool of evidence. So, clinicians are faced with a wealth of guidelines but a relative paucity of evidence, particularly when trying to determine the best practices for management of CAUTI.

Medicare rule changes in the USA and relevance to CAUTI

A brief discussion of the social changes that may have triggered this proliferation of guidelines is highly relevant. In January 2008 APIC launched its “Targeting Zero” campaign, which aims to completely eliminate HAIs [18*]. On October 1, 2008, Medicare(the US government’s health insurance program for senior citizens and persons with certain disabilities)stopped reimbursing US hospitals for several complications of hospitalization, including CAUTI that develops during hospitalization[4*]. Awareness of these impending changes was high and likely accounted for much of the increased interest in developing guidelines for prevention of CAUTI. Several experts have pointed out that reduction of CAUTI is reasonable goal but elimination is not feasible, particularly in patients who require long-term catheterization [5**–6]. The Medicare policy may paradoxically lead to a worsening of care, as hospitals are penalized for CAUTI that arises during hospitalization but not for CAUTI that was present on admission. Hospitals will likely encourage collecting more urinalyses and urine cultures at admission, even on asymptomatic patients, which in turn will lead to increased inappropriate use of antibiotics to treat ASB. On the other hand, two positive outcomes of the Medicare rule change are an increased focus on prevention of CAUTI and an increased interest in distinguishing CAUTI from ASB. Several excellent editorials address the potential consequences of this controversial rule change [4*–5**]and the potential impact of public reporting of health care outcome measures [19**].

Distinguishing CAUTI from CA-ASB

The majority of cases of nosocomial CAUTI are really asymptomatic bacteriuria (ASB)[20]. Per the 2005 IDSA guidelines, ASB is not a clinically significant condition, and treatment is unlikely to confer clinical benefit [21]. However, a significant gap between evidence-based guidelines concerning management of ASB and clinical practice has been documented in recent publications from the US, the UK, France, and Canada [22**, 23*, 24–25, 26*]. Substantial numbers of patients are being diagnosed inappropriately with CAUTI, for which they receive treatment that is not recommended. This inappropriate treatment is potentially harmful in terms of emergence of resistant pathogens, suprainfections, and unnecessary

costs. A recent study in 510 critically-ill, catheterized trauma patients further adds further support to these guidelines, as the presence of fever and/or leukocytosis were not associated with a positive urine culture [27*]. Likewise, catheter-associated bacteriuria was not associated with increased mortality in critically-ill medical patients [28].

Health care practitioners who seek clarification in the literature on how to define CAUTI and CA-ASB will encounter little evidence of what symptoms and signs define UTI in a patient with an indwelling catheter. Efforts to minimize inappropriate treatment of CA-ASB have been hampered by the difficulty of diagnosing this condition. The Loeb criteria for initiation of antimicrobial therapy in residents of long-term care facilities recommend that at least 1 of the following be present if antibiotics are given for CAUTI: fever, new costovertebral angle tenderness, new onset of delirium, or rigors [29]. These Loeb criteria were the basis of a treatment algorithm for suspected CAUTI that effectively reduced rates of antimicrobial prescriptions in long-term care facilities [30].

Several recent publications describe educational strategies to reduce over-diagnosis of CAUTI and over-treatment of CA-ASB. Two of these studies were uncontrolled pre-/post-studies in a geriatric (Bonnal et al) or long-term care facility (Zabarsky et al)[22*, 31*], while one was a controlled, pre-/post-study in an acute care hospital in France (Pavese et al) [32*]. All 3studies found a significant decrease in the use of antibiotics for ASB after implementation of an educational or feedback intervention, although the controlled study also found a decrease in unnecessary antibiotic use for ASB in the control group. One of the most interesting comments in the Zabarsky et al study is that many of the providers were unaware of existing IDSA guidelines for diagnosis and management of ASB [13]. Since these 3 interventions differed in the nature of the intervention, the intensity of the intervention, and the effort required to sustain the intervention, we cannot draw formal conclusions about the optimal approach to reduce mis-diagnosis of CAUTI through provider education.

New enthusiasm for prevention of CAUTI

One very positive recent development in the field of CAUTI is a new enthusiasm for prevention of CAUTI. In 2005 Saint et al performed a survey in 719 US hospitals of their UTI prevention practices [3**]. Fewer than 25% of hospitals had a system for monitoring which patients had urinary catheters, and fewer than 20% monitored the duration and/or discontinuation of urinary catheters. This finding is remarkable considering that length of catheter dwell time is clearly a risk factor for CAUTI, as confirmed by Wald et al's recently-published survey of 35,904 Medicare patients who had undergone major surgery [33*]. Wald et al also documented that the majority of Medicare patients ≥ age 65 who were discharged with a urinary catheter in place did not have an apparent reason for catheterization [34**]. Several strategies show promise for decreasing inappropriate insertion of urinary catheters and duration of catheterization, including a combined educational intervention and an indication checklist for use in an emergency department [35], and nurse-led multidisciplinary rounds in the hospital [36*]. These studies confirm earlier work along these lines concerning computerized stop orders for urinary catheters, computer-based order entry for urinary catheters, nurse-generated reminders, and nurse empowerment to remove catheters [37*].

There are two caveats to the catheter-avoidance approach to preventing CAUTI. First, it has not been definitively proven that decreased catheter use leads to decreased CAUTI. Stephan et al implemented a controlled, multifaceted intervention to restrict catheter use in surgical patients and found both a decrease in duration of catheter use and a decrease in CAUTI in the intervention group [38]. On the other hand, Loeb et al found that computerized stop

orders decreased days of urinary catheter use in hospitalized patients by 1.34 days but did not decrease CAUTI [39**]. One possible explanation for their negative finding is that the magnitude of the decrease in catheterization was not sufficient to translate into improved microbiological outcomes. Another possible explanation is that physicians continued to inappropriately diagnose CAUTI in subjects with ASB in both the intervention and control groups. Therefore, this Loeb study may serve as a warning that prevention of CAUTI will require a cultural shift in our understanding of what constitutes a CAUTI. Another caveat is that only 1 study has directly examined sustainability of the catheter-removal intervention and the level of effort needed to continue beneficial outcomes [40*]. Not surprisingly, the investigators found that commitment from the intervention team, physician involvement in the recommendations, and repeated efforts were necessary.

Various other prevention strategies generally fall under the headings of different types of catheters, different catheter materials, or alternatives to indwelling urinary catheters. At this point the evidence is insufficient to recommend the following potential alternatives to indwelling urinary catheters as a means to prevent CAUTI: antimicrobial catheters, intermittent catheterization, suprapubic catheters, and condom catheters. These topics have been covered in Cochrane reviews published prior to the past year [41–45].

The concept of antimicrobial urinary catheters continues to receive considerable press, somewhat out of proportion to the information available. Two excellent summaries of this topic are available: a review by Johnson et al published in 2006 and a Cochrane review published in 2008 [14, 46**]. Of the 12 trials included by Johnson et al, 3 were published only as abstracts. The Cochrane review of types of catheters for short-term voiding problems add 1 new study to those reviewed by Johnson, a high-quality study of nitrofurazone catheters by Stensballe et al [47]. To summarize, silver-alloy and nitrofurazone impregnated catheters may reduce the risk of catheter-associated bacteriuria during short term catheterization. A significant clinical benefit, such as reduction in symptomatic CAUTI, has not been demonstrated. No adequate studies have been done of antimicrobial catheters for long-term use (>30 days) [48], and in studies of short-term use the antimicrobial effect diminishes in the second week of use [46**]. One difficulty in interpreting the silver catheter studies is that earlier studies (prior to 1999) showed greater benefit of silver catheters than more recent studies. In many of the more favorable early studies, the silver hydrogel-coated (latex) catheters were compared to uncoated latex control cathters [49], thus raising the question of whether the beneficial effect was due to the hydrogel rather than to the silver. A large crossover study comparing silver alloy (silicone) to hydrogel silicone catheters in 3000 patients found no difference between groups, despite the fact that this was a pre/post study design and thus subject to Hawthorne effect bias [50]. Furthermore, this negative study relied upon clinically obtained urinary cultures rather than on urine cultures collected daily by study personnel, thus again raising the question of the clinical relevance of delaying the onset of bacteriuria. On the other hand, the Stensballe trial of nitrofurazone-impregnated silicone catheters vs. control silicone catheters found a significant delay in the onset of bacteriuria and fewer instances of new or changed antimicrobial therapy in the nitrofurazone group [47]. No clinical trial has compared 1 type of antimicrobial catheter to another [46**]. In vitro studies from 1999 using an agar plate diffusion model favor nitrofurazone catheters over silver hydrogel catheters [51].

We note a general trend at our hospital to substitute condom (external) catheters for indwelling Foley catheters. Condom catheterization is also mentioned consistently in guidelines as a potential alternative to indwelling catheterization, based mainly upon a study by Saint et al [52]. This prospective study randomized 75 male veterans to condom vs. indwelling catheters and found a trend towards decreased bacteriuria and a significant decrease in the combined outcome of bacteriuria, symptomatic UTI, or death in the condom

catheter group. Of note, of the 4,241 patients screened for this study, 4,144 did not qualify; prior evidence of urinary retention was one of the exclusion factors. Urinary retention is an appropriate justification for long-term catheterization and may prohibit use of condom catheters in many patients.

Update in management of CAUTI

Although practical issues of the management of UTI are probably the topic of greatest interest for clinicians, recent evidence to guide practice is limited. One frequent question is whether prophylactic antibiotics should be given at the time of urinary catheter removal to present subsequent UTI. A recent survey of 237 urologists, geriatricians, infection control nurses, and microbiologists in the United Kingdom found that 60% give antibiotics to the patient at the time of urethral catheter removal [53]. The best evidence supporting this practice was provided by a study by Harding et al published in 1991[54]. In this study, women who had persistent, asymptomatic bacteriuria 48 hours *after* catheter removal were randomized to no therapy, to 1 dose of trimethoprim-sulfamethoxazole, orto10 days of this antibiotic. In the no therapy group, 7 of 42 (17%) women developed a symptomatic UTI within 2 weeks, in contrast to none of70 treated women. Two more recent studies of prophylactic antibiotics enrolled subjects with and without existing bacteriuria at the time of catheter removal [55*–56]. In the study by Wazait et al, only 3 of 48 patients had catheter-associated bacteriuria; not surprisingly, a 48-hour course of ciprofloxacin did not affect the incidence of UTI within the following 2 weeks. Of the 205 subjects in the Pfefferkorn study, 74 (36%) had bacteriuria at catheter removal, and fewer treated subjects developed symptomatic UTI in the following 2 weeks. However, in the latter study, the subjects' lack of blinding may have affected their reporting of the subjective symptoms necessary to meet the criteria of UTI. At this point, no definite recommendation can be made about whether screening for and treating ASB is beneficial at the time of catheter removal in selected patient populations.

More evidence supports the practice of changing a long-term catheter prior to initiating therapy for a CAUTI. The previously reported discordance between catheter flora and urinary cultures was reaffirmed by a study by Matsukawa et al [57]. Simultaneous catheter and urine cultures done upon removal of short-term catheters found a significantly higher rate of positive catheter cultures than urine cultures (54% vs. 30% respectively, $P<0.01$). Raz et al had reported in 2000 that catheter change prior to treating CAUTI in 54patients with long-term catheters led to improved clinical and microbiological outcomes [58]. Of note, bacteriuria disappeared in 5 of 14 subjects with catheter change alone. Their hypothesis for the improved clinical outcomes with catheter change was that removal of the "bioburden" of the catheter-associated biofilm helped decrease the severity of inflammation and the probability of recurrence. From the point of view of obtaining accurate microbiology results, catheter change prior to culture is advisable. However, from a practical standpoint, it is not realistic to expect health care personnel to remove and/or change a urinary catheter prior to collecting all urine cultures, so perhaps the catheter should be changed once the diagnosis of CAUTI has been made, early in the course of treatment.

Another pressing clinical question is the duration of antibiotics necessary to treat CAUTI. Most recommendations are based upon expert opinion, and support can be found for durations ranging from 5 to 14 days. Autopsy studies have clearly established that occult, chronic pyelonephritis is very common in persons with long-term urinary catheters [59–60]. In the Harding et al trial [54], single dose therapy with trimethoprim-sulfamethoxazole was comparable in terms of resolution of post-catheterization cystitis to 10 days of therapy with this drug, but single dose therapy was less effective in women > 65 years of age. Dow et al studied 3 vs 14 days of ciprofloxacin for persons with spinal cord injury and suspected lower

urinary tract infection [61]. Most of these subjects were practicing intermittent catheterization; none had indwelling catheters. The microbiological cure was better in the 10 day group, but clinical outcomes were the same between the two groups. It seems likely that the appropriate duration of therapy for CAUTI lies between 3 and 14 days, and the duration of catheterization is likely to be an important variable in determining the optimal duration of therapy. No recent comparative studies have addressed the optimal choice of antibiotics for CAUTI or the optimal delivery route (oral vs parenteral).

Conclusion

These recent guidelines and publications increase our awareness of the problem of CAUTI but leave significant gaps in our knowledge. Of particular concern is how little recent evidence supports our current treatment strategies for CAUTI. This deficit arose in part because only recently has the distinction between ASB and CAUTI entered general awareness. We now need new trials with appropriate focus on symptomatic CAUTI to determine how long to treat this infection. Furthermore, the diagnosis of CAUTI is not easy to make in a catheterized patient, and validated diagnostic algorithms and clinical markers of UTI would be welcome. Better understanding of the pathogenesis of the transition of ASB to CAUTI might help determine which laboratory parameters to study.

The efforts to reduce urinary catheter use are commendable and appropriate, but they leave open the question of what to do with the patients who have a legitimate need for urinary catheter and who are thus at high risk for CAUTI. Currently the utilization of urinary catheters in US skilled nursing facilities is around 5%, many of which are placed for appropriate indications such as relief of urinary obstruction [62*]. As the US population aged 65 to 85 years is increasing rapidly [9*], impaired bladder emptying secondary to prostatic hypertrophy, stroke, or diabetes will become more common. Therefore, the problem of how to manage catheter-associated bacteriuria and CAUTI will become even more relevant in coming years. Ideally the unanswered questions in this field will be an inspiring challenge for the current and future generations of clinical investigators.

Acknowledgments

This work was supported by Department of Veterans Affairs Rehabilitation Research & Development Service Career Development Award B4623W and NIH grant HD058985.

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