and if this hypothesis proves to be true, physiologic and pathologic bidirectional communication between alveolar epithelial cells and fibroblasts/myofibroblasts should become the main target for research. In the same line of thought, we need to understand why bronchiolitis obliterans organizing pneumonia is typically reversible while IPF/UIP is usually progressive and irreversible, despite the striking similarity between Masson's bodies and fibroblast foci. Thirdly, we need to generate new therapeutic approaches to improve survival and the quality of life and, if possible (and it surely will be), to cure this terrible disease.

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Nosocomial Urinary Tract Infections And the Indwelling Catheter

What Is New and What Is True?

The urinary catheter is an essential part of modern medical care. It is widely used to relieve anatomic or physiologic obstructions, to provide a dry environment for comatose or incontinent patients, and to permit the accurate measurement of urinary output in severely ill patients. Unfortunately, when used inappropriately or when left in place too long, it is a hazard to the very patients that it is designed to protect. Catheter-associated urinary infections account for about 40% of all nosocomial infections and increase the duration of hospital stays, the costs, and mortality.1,2 Systemic antimicrobial therapy may temporarily reduce the bacterial count in the bladder urine but cannot eradicate infections in patients with indwelling urinary catheters.3,4 Inappropriate and excessive use of antimicrobial drugs leads to the selection of antibiotic-resistant microorganisms and nosocomial outbreaks of infection with multiresistant strains.

One would expect that prevention of catheter-associated infection would have a very high priority for research sponsored by the government and the health-care industry. The Centers for Disease Control and Prevention (CDC) and hospitals continue to emphasize surveillance. This helps to document the problem, but does not provide solutions. The CDC guidelines for the prevention of catheter-associated infections have not been updated since 1983.5 The National Institutes of Health sponsor a great deal of research focused on the molecular mechanisms of sepsis but not on the cause. Most of the innovations
in this field have come from the equipment manufacturers. There has been very little motivation for true innovation except for the relatively recent development of antimicrobial impregnated catheters. Catheters and drainage bag systems are considered to be a commodity competing for the lowest expenditures that hospitals will support. There appears to be minimal oversight by the Food and Drug Administration. The only effective control is competition among manufacturers and the efforts of a small cadre of devoted clinical investigators.

The mechanisms by which the indwelling catheters produce infection are now well established. These consist initially of ascending colonization of the urethra and the catheter surface. The technologic requirements to design better catheters and drainage systems are fairly well-known. Dukes demonstrated the efficacy of closed drainage to block ascending infection in 1928. Disposable closed drainage systems became widely available almost 40 years ago. None of the numerous attempts to improve the system have been shown to be more effective than simple closed drainage. In the this issue of CHEST, Leone and colleagues (see page 220) found no difference in the acquisition of bacteriuria between a simple two-chamber drainage bag and a complex system consisting of a preconnected coated latex catheter, a tamper-discouraging seal, a drip-chamber, an antireflux valve, a drainage bag vent, and a povidone-iodine-releasing cartridge at the drain port. It is surprising that this complex system is still on the market since all of these measures have been shown to be ineffective. The only truly novel drainage bag that I am aware of is a nonreusable system containing a water-absorbing polymer that traps bacteria and urine. It is purported to avoid ascending infection and cross-contamination, but this needs to be evaluated in properly conducted controlled trials.

Attempts to block the periurethral route by coating catheters with antimicrobial agents are currently receiving considerable attention. These agents include silver oxide, silver hydrogel (silver alloy), nitrofurazone, and combinations of minocycline and rifampin. The current favorites are the catheters coated with silver alloy and nitrofurazone. Nitrofurazone has been shown to be superior to silver hydrogel according to in vitro studies of activity against microorganisms that commonly cause catheter-associated infection. Some of the clinical trials are well-designed prospective studies that determine the daily rate of acquisition of bacteriuria. Others are crossover studies that use clinical criteria to identify patients with infections. The crossover studies are usually not blinded and do not provide daily end points. It is, therefore, somewhat difficult to assess their true efficacy in preventing acquisition of bacteriuria. For example, a preliminary account of a double-blind, prospective study of a silver-hydrogel-coated catheter reported a decrease in infections caused by enterococci, coagulase-negative staphylococci, and Candida but showed little effect against Gram-negative bacilli. The same authors reported a fivefold reduction of the acquisition of bacteriuria with a nitrofurazone-impregnated catheter, but the reduction did not reach statistical significance. On the other hand, trials using clinical end points report reductions in the incidence of symptomatic urinary tract infections of 47% and 21%. A clinical trial of the catheters coated with minocycline and rifampin found a significantly reduced rate of Gram-positive, but not Gram-negative, bacteriuria.

Several points need to be considered before hospitals decide to purchase impregnated catheters. These include an approximately sixfold greater cost and lack of efficacy once bacteriuria is acquired. It does not seem appropriate to use these more expensive catheters in medical or surgical patients who require only a few days of drainage or in long-term care facilities where virtually all of the patients are already infected. The allocation of catheters can become a logistical nightmare for hospitals. Often it is difficult to predict how long a catheter will be needed, particularly in ICUs. The determination of the acquisition of bacteriuria requires periodic cultures and increases costs. Although silver and nitrofurazone catheters have been reported to be safe in clinical trials, it is possible that allergies or other adverse effects may occur with more widespread use. We need to remind ourselves that until recently latex was considered to be safe. All latex products had to be removed from hospitals because of a few, but important, allergic reactions. Argyria is a potential problem for long-term-care patients. Furthermore, silver-resistant mutants of Escherichia coli can be selected by stepwise exposure.

Catheters are fairly rigid structures. They drain the bladder, but they block the urethra. The challenge is to produce an instrument that matches as closely as possible the normal physiologic and mechanical characteristics of the voiding system. This requires construction of a thin-walled, continuously lubricated, collapsible (conformable) catheter to protect the integrity of the urethra; a system to hold the catheter in place without a balloon; and measures to imitate the intermittent washing of the bladder urine. The efficacy of each component of the system will need to be evaluated in carefully conducted, controlled clinical trials. There is also a major need for better fitting male condom catheters and for external...
urine collection devices for incontinent women. Catheters of the future may be more expensive but may be well worth the investment if used in the appropriate population.

There is no need to wait for a mechanical or chemical answer to the problem of nosocomial urinary tract infections. The culprits are unnecessary and prolonged use of catheters when they are no longer needed. Oliguric patients do not need catheters. Urinary output can be measured using noninvasive portable ultrasound devices. Bladder ultrasound combined with intermittent catheterization, as needed, or condom drainage should help to eliminate catheter use in ICUs except during massive hydration. It may be possible to develop a recording bladder ultrasound device that can measure urine output in real time. This might replace the urinary catheter to measure urine output in ICUs just as ear oximeters have replaced intra-arterial lines for the measurement of BP and blood gases.

Improvements in catheter and drainage bags are needed, but these cannot substitute for thoughtful care. We must ask ourselves on daily rounds: “Is this catheter really needed? When can I take it out? Are there alternate measures? Can a portable ultrasound help determine when a catheter may be needed?”

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