Efficacy of an Attachable Silver Impregnated Subcutaneous Cuff for the Prevention of Catheter-Associated Infections in Patients on Chronic Maintenance Hemodialysis

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Dear Sir,

Infection was noted to be a common and serious complication of renal failure long before the development of maintenance dialysis [1] and was often listed as the chief cause of death [2]. Even now, sepsis remains a leading cause of morbidity and mortality in patients with chronic renal failure [3, 4] despite our technological success. In our population of patients with end stage renal disease (ESRD) in Opelika, Alabama, sepsis was the leading cause of mortality between 1982 and 1987, being responsible for 27% of all our ESRD deaths. That was consistent with reports from other centers that have established infection as the cause of deaths in 11-38% of all patients on hemodialysis [3, 5-8]. The reasons for the high morbidity and mortality have in the past been attributed to altered host defenses since uremia promotes defects in cellular [9-14] and humoral immunity [15, 16]. However, we have previously reported that the serum bacteriocidal activity in hemodialysis patients [17] is generally normal and most studies suggest that the principal cause of sepsis in those patients is due to the loss of the integrity of the skin as a defense barrier to bacterial invasion of the blood stream [5] that accompanies the need for a hemodialysis vascular access [18]. Over the last 15 years the widespread use of subclavian catheters for temporary vascular access has further violated that barrier and only increased the incidence of sepsis. Bacteremia has been reported in 15-55% [19, 20] of all subclavian hemodialysis catheters. One group has reported 77% of all admissions for sepsis in the first 3 months after the initiation of dialysis to be related to subclavian catheter use [21]. In 1989 sepsis was responsible for 27% of our hospital days with 75% of hospitalizations for sepsis related to an indwelling subclavian catheter. At that time an attachable silver-impregnated cuff had been shown to decrease the incidence of infections in Swan-Ganz and nondialysis-associated subclavian catheters [22-24]. We therefore devised the following study to evaluate the efficacy of these cuffs for the reduction of catheter-associated sepsis in hemodialysis patients.

During March 1990 the first 4 hemodialysis patients requiring a temporary vascular access received a subclavian catheter with an attachable silver-impregnated cuff (Vita-Cuff™; fig. 1). Since intrajugular catheters have been associated with a significantly higher risk of infection than subclavian catheters [25], all patients requiring an intrajugular catheter were excluded. Similarly, all patients with a history of an active infection, prior transplantation or current therapy with immunosuppressive medication were excluded. All patients had serum ferritin values of greater than 100 but less than 500 mg/l. These patients were then followed in the chronic hemodialysis

unit until their permanent access was suitable for cannulation and their temporary access could be removed. A second group of 4 patients requiring a temporary subclavian catheter for hemodialysis were

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VITA CUFF

Fig. 1. VitaCuff placement. The cuff slips over catheter at the time of insertion to reside just beneath the skin surface to provide an antiseptic barrier to bacterial migration.

then identified and matched as closely as possible for age, sex, race, and the presence of diabetes (table 1).

Both groups were followed for the development of infection and duration of catheter use. The organism and length of time to infection and catheter removal were noted.

The equality of the two percentages of rates of infection were tested for independence based on the arcsin transformation with paired comparisons.

Despite a slightly older age (mean 64 vs. 58 years), no infection developed in the control group, but 75% of the patients whose catheter carried the silver-impregnated cuff developed infection (table 2). That was statistically different. Two of three episodes of sepsis were due to *Staphylococcus aureus* while the other patient developed gram-negative sepsis with *Enterobacter cloacae*. The mean

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Table 1. Patient population: matched for age, sex and presence of diabetes mellitus

Table 2. Results: significantly higher rate of sepsis in VitaCuff-treated group despite similar catheter duration

Patient	Age	Sex	Diabetes
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No.	years		
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Patient	Duration of	Development	Reason for
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No.	catheter use, days of	sepsis	catheter removal
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Controls	
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VitaCuff	
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duration of catheter use was almost equal (79 vs. 75 days) and in both groups 75% of the patients had ESRD due to diabetic glomerulosclerosis.

Previous attempts to reduce the incidence of hemodialysis catheter-related infections have included improved nursing training [26], topical antiseptics [27], occlusive dressings [28] and the development of a Silicon rubber intrajugular catheter with a Dacron cuff inserted through a subcutaneous tunnel [29]. Each event was associated with a reduction in infectious complications but also accompanied by specific problems. Because of high nursing staff turnover in many dialysis units, inexperience has often offset improved training efforts. Topical betadine was effective for staphylococcal antisepsis but can also allow adequate growth of *Pseudomonas*. Occlusive dressings were associated with trapping moisture and increased bacterial growth. Finally the inconvenience of surgical removal required for the implanted Silicon catheter has

resulted in patient reluctance to accept that catheter, which required an additional surgical procedure and some investigators have found the creation of the subcutaneous tunnel to be of no advantage in reducing infections [30], with infection rates of 18.75% [31].

The silver impregnated cuff is situated just beneath the skin surface at the time of the subclavian vein catheter insertion (fig. 1). The collagen cuff releases silver ions into the skin over a period of weeks. Silver ions have been thought to have a broad spectrum of antimicrobial activity against bacteria and fungi likely to cause catheter-related infection. We found the convenience of insertion attractive since it avoided a subcutaneous tunnel and surgical removal. Previous studies demonstrated that the organisms were less likely to move down the catheter for colonization or infection of the blood stream [22]. Furthermore, studies have suggested that catheter-related infections were reduced for nondialysis patients with indwelling subclavian catheters who were hospitalized in intensive care units [22-24]. While it is very difficult at times to assess the results of a short pilot study such as ours, we can certainly report that we found no such benefit in the population that we studied. Indeed the results would indicate that the cuff actually increased the risk of sepsis.

The reason why we found no benefit to the silver-impregnated cuffs may be no more than our small sample size and the answer remains beyond the scope of this brief report to ascertain. However, other possible reasons may include the possible explanation that the previously reported immune deficits in the ESRD population are substantial enough to prevent the chemoprotection that has been reported for these cuffs in central venous catheters in patients without renal failure. Unfortunately that explanation would only explain why they were of no benefit and would not explain why there was actually an increased incidence of sepsis in the study group compared to their matched controls. Perhaps, the additional step of actually placing the cuff onto the catheter was one more step where contamination could occur. The same rationale of course would be true for previous studies with nondialysis patients requiring central venous catheters; however, unlike the nondialysis patients, the dialysis patients require repeated manipulations of their catheters by the nursing staff during dialysis treatments, often several times during each treatment to provide adequate flow. Perhaps the efficacy of the silver-impregnated cuffs is diminished as it is repeatedly dislodged and twisted during each treatment with the repetitive manipulations necessary to sustain adequate flow through the catheter to continue the treatment. That, of course, would indicate that the nursing care of the catheter would strongly influence the incidence of infection whether or not there was a protective cuff present. Unfortunately the presence of a 'protective cuff might have even promoted a false sense of security within the nursing staff that resulted in less conscientious antiseptic care. Improved nursing care and local antiseptic treatment have been documented to be beneficial in preventing catheter-related sepsis and will most likely remain the cornerstone of prevention. We find no data to recommend the use of the silver-impregnated cuff for prevention of infection associated with hemodialysis catheters.

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VitaCuff for the Prevention of Infections in HD

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