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The treatment of hemodialysis catheter related bloodstream infection: The role of guidewire exchange

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Tunneled cuffed catheters have a crucial role in the treatment of acute and chronic renal failure with dialysis. In 1996, 18.9% of all new hemodialysis patients were using tunneled catheters, compared with only 9.7% of patients in 1993 (1).

However, their use is frequently complicated by serious infections. Data from prospective cohort studies or randomized controlled trials indicate that if a patient receives a tunneled, cuffed catheter there is an approximately 30% chance they will experience bacteremia (2-7). These bacteremic events may be further complicated by infections such as endocarditis (8-10), osteomyelitis (10-12), septic arthritis (10, 13-15), or even death (8-10, 16-18).

The two primary mechanisms of catheter related bloodstream infection (CR-BSI) are 1) migration of organisms down the subcutaneous tract at the insertion site; 2) introduction of organisms into the lumen of the catheter, usually from colonized catheter hubs (19). The relative importance of these mechanisms changes depending on the type of catheter and the duration of use. In a study of oncology patients, Raad et al demonstrated that the intraluminal mechanism was more important after catheters had been in place for 30 days (20). Frequent manipulation of the hub also increases the risk of intraluminal colonization (21, 22). Both these conditions are relevant to tunneled cuffed hemodialysis catheters; Almiral (14) and Cheesrough (9) both demonstrated that over 50% of infections were related at least in part to interluminal colonization. With today's widespread use of tunneled cuffed catheters, the intraluminal route is likely to be even more prevalent, although careful studies of the pathophysiology of infection related to tunneled, cuffed hemodialysis catheters are not available.

Intraluminal contamination leading to CR-BSI is indirectly implied by a number of observations. First bacteremia often occurs in the absence of exit site or tunnel infection. Second, increased attention to meticulous sterile technique during connection and disconnection can reduce infection rates associated with hemodialysis catheters (personal communication, Gerald Beathard).

Third, there are preliminary reports that intraluminal instillation of gentamicin/citrate can reduce infection rates.

Two studies report the elimination of CR-BSI using this technique (23, 24); these studies did not have concurrent controls but did observe over 10,000 catheter days in the largest study of the two. The expected number of CR-BSI over this time would be approximately 11 if average rates of infection occurred. This technique would likely only be successful if intraluminal colonization was a significant source of bacteremia. Fourth, cultures of the outside of the catheter tip during CR-BSI are often negative (25).

Previously complete removal of infected catheters was considered a paradigm of management, as is still recommended for temporary (non-cuffed non-tunneled) hemodialysis catheters. However, the increased use of tunneled cuffed catheters has made removal more difficult.

Furthermore, these infections have often occurred in patients who were using catheters as a last resort and as such had limited options for vas-

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cular access. Initial attempts at eradicating CR-BSI while leaving the catheter in place proved mostly unsuccessful (6, 10, 26). In a larger study, Marr and colleagues reported that only 20 of 62 (32%) CR-BSI was eradicated with intravenous antibiotics and leaving the catheter in place. The rate of secondary infections was also high.

If the primary route of colonization and eventual CR-BSI is intraluminal it follows that guidewire exchange is a reasonable management option.

Guidewire exchange is likely to remove the primary source of the infection even if some contamination should occur at the time of exchange as the wire is inserted into a lumen that is colonized. In contrast if the catheter were inserted into a contaminated tunnel (not grossly infected), infection would be likely to return as it tracts down the outside of the new catheter.

Patients are eligible for guidewire exchange if they have confirmed or probable CR-BSI. Controversy exists as to the exact definition, but patients must have no other identifiable source of infection and have a positive peripheral blood culture or symptoms and signs compatible with sepsis. If these symptoms are severe, however the catheter should be removed as soon as possible. If the patient has only mild symptoms exchange is possible but they first should receive empiric antibiotic coverage (usually vancomycin and gentamicin). Clinical signs of infection should improve and the catheter can be exchanged in 48-72 hours. Patients should be observed carefully in the interim, so that if they deteriorate clinically the catheter can be removed immediately. Removal of the CVC is also recommended for fungal infections (27).

At the time of guidewire exchange, the guidewire is usually inserted through the catheter hubs. Alternatively the CVC can be divided at its insertion site or just proximal to its entry into the vein through a separate skin incision. The former has been advocated to minimize contamination of the wire; the latter allows creation of a new tunnel and exit site if needed.

A number of non-randomized cohort studies report success with guidewire exchange to treat CR-BSI associated with tunneled cuffed hemodialysis catheters (Tab. I). The studies lack uniform entry criteria, management, outcome definitions, and follow-up. All studies excluded very ill patients and most required the absence of tunnel or exit site infection, so of the CR-BSI observed only 45-71% were eligible for exchange.

Success was defined as the eradication of bacteremia over variable periods of follow-up. Two studies provided uniform follow-up of 45 and 90 days (7, 28). In the absence of exit site or tunnel infection, the successful eradication rate of CR-BSI is 81-100%. In the presence of exit/tunnel infection the success rate drops to 64% (7). Tanriover et al studied a cohort of patients in which guidewire exchange versus removal was based on the physicians judgement if patient has mild symptoms, no exit infection and defervesced on antibiotics (29). There was no difference in infection free survival with a hazard ratio of 0.88 (0.43-1.79, p = 0.72) between the exchange and removal group adjusting for age, sex, race, diabetes, type of organism (gram positive/gram negative), and albumin.

In the same studies, secondary complications were endocarditis, septic arthritis, septic emboli to the brain, epidural abscess, septic discitis, and sepsis requiring intensive care admission (Tab. I). Complications did not predominate in the guidewire exchange group. The one case of discitis was thought by the authors to be unrelated because it occurred 144 days after the exchange and the discitis. Beathard reported one case each of an epidural abscess, septic arthritis, and endocarditis, but in the control group that received immediate catheter removal.

Tanriover et al found an equal number of secondary infections between the removal and guidewire exchange group. These observations suggest that secondary infections may have already occurred at presentation and may be related to the severity of the infection rather that to the use of guidewire exchange.

These studies provide the support for the recommendations by the National Kidney Foundation – Dialysis Outcomes Quality Initiative that guidewire exchange is a viable option in patients with CR-BSI (27).

This technique may eradicate CR-BSI and avoid the need for further vascular access procedures. However the risk-benefit of this procedure cannot be completely evaluated.

Ideally patients should be randomized to guidewire exchange or immediate removal of the catheter. Only through randomization can known risk factors for infection (e.g., severity of presentation, nasal carriage, and diabetes) as well as unknown factors be balanced. Follow-up should be uniform and clearly describe how recurrent bacteremia or secondary infections are detected. Since the immediate removal group is likely to have a decreased risk of infection at least in the short-term, attempts should be made to quantify the benefit patients experience by avoid-

TABLE I - STUDIES OF GUIDEWIRE EXCHANGE IN THE TREATMENT OF HEMODIALYSIS CATHETER RELATED BLOOD STREAM INFECTION

	Procedure	Indication	Eligible %	N.	Co-Intervention	Follow-up (months)	Definition of success	Success (%)	Secondary infection
Carlisle, 1991 (26)	Exchange	No tunnel/exit site infection	50	4	n/a	n/a	n/a	100	
Shaffer, 1995 (25)	Exchange	No tunnel/exit site infection	71	10	1-2 weeks of antibiotics	1-13	n/a	100	
Robinson, 1998 (28)	Exchange	Defervesence after 48 hours No tunnel/exit site infection	58	21	Empiric gentamicin and vancomycin followed by 3-4 weeks of antibiotics	3	No bacteremia of any kind	81	1 discitis
Beathard, 1999 (7)	Exchange	Mild symptoms [a] No tunnel/exit site infection	43	49	Empiric gentamicin and vancomycin then followed by 3 weeks of antibiotics	1.5	No recurrence of bacteremia from the same organism after 45 days	100 [d]	
Beathard, 1999 (7)	Exchange	Mild symptoms [a] No tunnel/exit site infection	25	28				64 [d]	
Beathard, 1999 (7)	Remove	Serious symptoms [b]	32	37				91 [d]	1 epidural abscess 1 septic arthritis 1 endocarditis
Tanriover, 2000 (29)	Exchange	No severe sepsis [c] No tunnel/exit site infection Defervesence on antibiotics Physician preference	45	31	Empiric gentamicin and vancomycin then followed by 3 weeks of antibiotics	variable	Infection free survival	48	7-specific type na
Tanriover, 2000 (29)	Remove	No severe sepsis [c] No tunnel/exit site infection Defervesence on antibiotics Physician preference	55	38		variable	Infection free survival	58	6 - specific type na

[a] combination of chills, fever, nausea, malaise, back pain

[b] combination of rigors, high fever, hypotension, nausea, vomiting and mental changes

[c] persistent shaking chills or hypotension

[d] indeterminate endpoints were catheter removal or death before 45 days of follow-up or bacteremia from a different organism than original; these endpoints are censored from the calculation of success rates

ing vascular access procedures so that benefit can be weighed against any increased risk of infection. Finally, the study should be powered adequately to detect a clinically meaningful difference in patient outcomes.

In summary, guidewire exchange can eradicate CR-BSI related to cuffed tunneled hemodialysis catheters. It may be efficacious because intraluminal contamination of catheters is the primary mechanism of CR-BSI for hemodialysis patients. Guidewire exchange to treat CR-BSI may avoid the need for temporary access, but must be used with good clinical judgement. Only patients with mild symptoms of infection and no exit or tunnel infection should undergo exchange, and when they do close observation is mandatory. It may be possible to also eradicate CR-BSI with a concomitant exit or tunnel infection by guidewire exchange, but further study is required. Whether this technique is overall beneficial for patients remains to be demonstrated in randomized controlled trials.

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