Erosion of the Silicone Peritoneal Dialysis Catheter with the Use of Gentamicin Cream at the Exit Site

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Infection remains the leading complication of peritoneal dialysis (PD). Topical mupirocin and gentamicin are frequently used to prevent infections. Mupirocin ointment has been reported to cause damage to both polyurethane and silicone PD catheters. Gentamicin cream has not been associated with physical damage to catheters.

A 64-year-old woman on PD developed relapsing peritonitis with Staphylococcus epidermidis. *Because of a drainage problem and white discoloration at the exit site, which is known as "frosting," she underwent catheter exchange. The catheter was found to be fractured within the area of frosting. Four more patients with frosting of the catheter were identified. On further questioning, it was recognized that they were applying excessive amounts of gentamicin cream directly on the catheter surface rather than at the exit site. All patients in the program were educated about the correct method of topical antibiotic application. After the change in practice, no further cases of catheter frosting were identified.*

Polyurethane catheters can undergo oxidation, mineralization, and environmental stress cracking, leading to physical damage such frosting, ballooning, and fracture. Polyethylene glycol, a component of the mupirocin ointment base, is thought to cause plasticization of polyurethane, reducing its tensile strength. Similar damage has been observed in silicone catheters. Previous reports have not found gentamicin cream to cause that type of damage. We observed that excessive amounts of cream applied directly to the catheter surface can damage it. Damage did not recur once patients had been educated about the proper method of application.

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Key words
Peritoneal dialysis catheters, erosion, peritonitis, mupirocin, gentamicin

Introduction

The prevalence of end-stage renal disease in the United States has been increasing. As of December 2012, 636,905 prevalent cases of end-stage renal disease were documented (1). A decrease in the number of living donor transplantations and a long wait list for deceased donor transplantation means that most of those patients proceed to dialysis. The percentage of patients starting peritoneal dialysis (PD) has recently been increasing, mainly because of new incentives for the PD modality in the prospective payment system for dialysis patients (2).

Infection remains the leading complication in PD (3). Topical antibiotics such as mupirocin and gentamicin have been used for the prevention of PD catheter exit-site infection and peritonitis. Mupirocin ointment, although effective in preventing infection, has been reported to cause PD catheter damage (4). Initial reports suggested that the use of mupirocin ointment on polyurethane PD catheters was responsible for physical damage to the catheter (5). Subsequently, similar findings were reported for silicone rubber catheters (6).

Gentamicin has not previously been associated with physical damage to the catheter, but we recently identified several cases of damage to silicone PD catheters related to improper use of gentamicin cream for exit-site care.

Case description

A 64-year-old woman with a history of end-stage renal disease on continuous ambulatory PD for 1.5 years was twice admitted to hospital with relapsing peritonitis. Her peritoneal fluid culture grew *Staphylococcus*

epidermidis, and she was treated with intraperitoneal vancomycin on both occasions. Resolution of peritonitis between the two episodes was documented by a decrease in the peritoneal effluent neutrophil count.

Because of relapsing peritonitis and problems with drainage, the patient was referred for a catheter exchange. The catheter was examined beforehand and was found to have an area of white discoloration ("frosting") and dilatation ("ballooning") at the exit site, thought to be cuff extrusion (Figure 1). On removal, however, the catheter was noted to be fractured within the affected area. It broke easily at the site of fracture (Figure 2). The fractured catheter was thought to be the cause of the relapsing peritonitis. During the post-peritonitis teaching session, it was noted that the patient's caregiver was applying an excessive amount of gentamicin cream directly on the catheter rather than at the exit site.

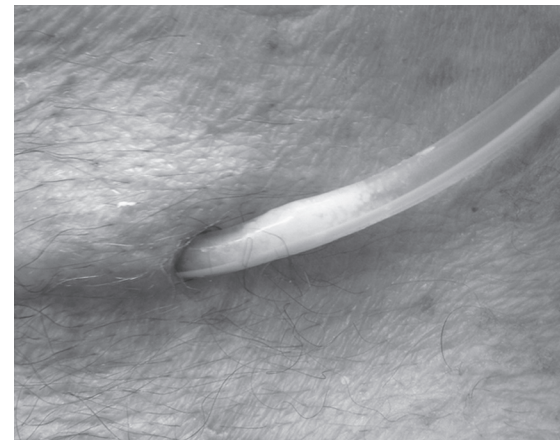

FIGURE 1 Frosting and ballooning of the peritoneal dialysis catheter at the exit site.

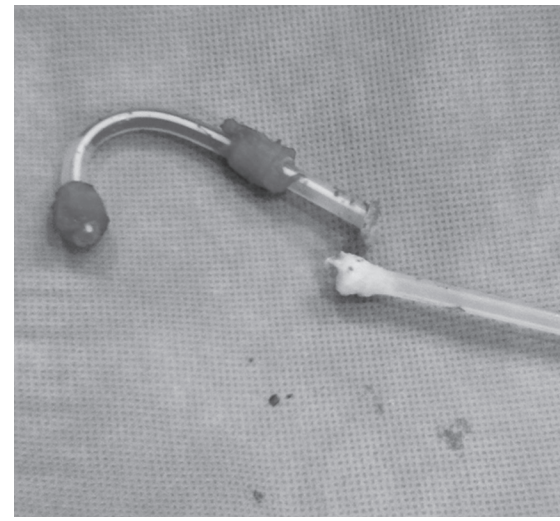

FIGURE 2 Fractured peritoneal dialysis catheter after removal.

Results

After the present case, 4 more cases of catheter discoloration and disfigurement were identified. Among the affected patients, one had her catheter removed after an episode of peritonitis, and the catheter was found to show frosting and ballooning (patient 2, Table I). Another patient did not have peritonitis, but had his catheter replaced because of drainage problems. His catheter was found to be permanently kinked within an area of frosting (patient 3, Table I). Two patients were noticed to have catheter frosting, but neither developed peritonitis or catheter malfunction. One of those patients was in hospice care and died soon after the discovery of the catheter surface changes, and so her catheter was not replaced (patient 4, Table I). The other patient was found to have a thinned area away from the exit site, which was repaired (patient 5, Table I).

On further investigation, it was discovered that, in all cases of catheter frosting, the patients or their caregivers were applying excessive amounts of gentamicin cream directly onto the catheter surface rather than at the exit site. All patients in the PD program were subsequently re-educated about the proper use of gentamicin cream. After the education sessions, no further cases of catheter surface alteration were identified.

To determine the impact of catheter erosion on the rate of peritonitis, we compared the rates of peritonitis in our PD program before and after the patient education. We observed no difference in the rate of peritonitis: 28.6 episodes in 100 patient–years compared with 30.3 in 100 patient–years respectively ($p = 0.90$)

Discussion

Physical damage in the form of frosting, ballooning, fracture, and rupture are rare complications of PD catheters. Rao and Oreopoulos (4) reported a case of spontaneous fracture of the polyurethane catheter in a patient who was using mupirocin ointment for prevention of exit-site infection

TABLE I Characteristics and outcomes of the patients

Pt ID	*Age (years)*	*Sex*	*Peritoneal dialysis*		*Presenting complaint*	*Silicone catheter*	
			Duration	*Type*		*Physical findings*	*Disposition*
1	64	F	1.5 Years	CAPD	Relapsing peritonitis and catheter malfunction	Frosting, ballooning, and fracture	Replaced
2	44	F	2.5 Years	CAPD	Peritonitis	Frosting and ballooning	Replaced
3	67	M	1 Month	CCPD	Catheter malfunction	Frosting and kinking	Replaced
4	80	F	2 Years	CCPD	None	Frosting	None
5	10	M	4 Years	CCPD	None	Frosting	Repaired

Pt = patient; F = female; CAPD = continuous ambulatory peritoneal dialysis; M = male; CCPD = continuous cycling peritoneal dialysis.

after recurrent peritonitis. Riu *et al.* (5) reported spontaneous rupture of a polyurethane catheter under similar circumstances. As a result, the use of mupirocin ointment is not recommended with polyurethane catheters (3).

Silicone rubber catheters have replaced polyurethane catheters at many centers. A randomized trial using mupirocin for prophylaxis of *Staphylococcus aureus* infection did not report any effects on the silicone catheters used in the study population (7). Subsequently, Khandelwal *et al.* (8) reported 9 patients with catheter surface alterations, including opacification, ballooning, and splitting. Of the patients in that group, 93% were using mupirocin for exit-site care. All had silicone catheters.

The underlying mechanism for these catheter complications remains unclear. Coury *et al.* (9) postulated that polyurethane catheters can undergo mineralization, oxidation, and environmental stress cracking. Such changes can lead to formation of crazes and microscopic cracks. If the crazes are shallow and uniformly distributed, they can lead to the white appearance on the catheter called "frosting." With time, the crazes can deepen, weakening the catheter structure and leading to the localized dilatation called "ballooning" and eventually breaking the catheter integrity, resulting in fracture or rupture. Absorption by the catheters of plasticizing material from their surroundings could reduce the catheter's tensile strength, serving as a sentinel event for all the sequelae already mentioned. Earlier reports about polyurethane catheters suggested that the polyethylene glycol component of mupirocin ointment might be the causative agent (4,10). A similar mechanism has been suggested but not proved in silicone catheters. *In vitro* experiments with both polyurethane and silicone catheters failed to produce similar changes, indicating that other unidentified *in vivo* factors might be contributing to the changes (9,10).

Compared with mupirocin prophylaxis, topical gentamicin prophylaxis has been shown to be equally effective against *Staphylococcus aureus*–related infection but superior against *Pseudomonas aeruginosa*–related infection in PD patients (11). To date, no previous report of gentamicin cream causing similar damage has been published. The commonly used 1% gentamicin sulfate cream contains propylene glycol in its base; that glycol ether is similar to polyethylene glycol and might have similar effects on catheter surfaces (12).

The patients in our case series had been on PD for variable periods. That observation suggests that the reported damage might not depend on the duration of catheter use. In fact, 1 patient developed frosting only 1 month after catheter placement. Of the 5 patients reported here, 2 were on continuous ambulatory PD, and 3 were on continuous cycling PD, indicating a lack of any association with the PD type.

We observed that the damage to the catheter appeared to be caused by the application of excessive amounts of gentamicin cream directly on the catheter surface; damage did not recur once patients had been educated about the proper method of application. We therefore concur that application of antibiotic creams in the proper amounts and at the proper site should not cause catheter damage.

Conclusions

Peritonitis and catheter malfunctions are the leading causes of conversion to hemodialysis, with the latter

accounting for 20% of conversions (13). Proper use of topical antibiotics is essential to prevent catheter surface alterations and malfunctions. Our case series highlights the importance of ongoing education of the PD population. At our center, education and a change in exit-site care practice resulted in complete avoidance of this serious complication.

Disclosures

None of the authors has any financial conflict of interest to disclose.

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