Infusion Catheter Sepsis:
An Increasing Threat

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THE AVAILABILITY of plastic infusion catheters introduced by venipuncture provides a great convenience for physicians and considerable comfort for patients requiring prolonged fluid therapy. There has been an increase in incidence, however, of a serious complication attributable to their use; namely, septicemia from infection at the infusion site. The following report of seven recent instances indicates that this complication occurs earlier than suspected and that organisms involved are not those considered skin contaminants.

Case Reports

Case 1. A 43-year-old man was admitted for elective vagotomy and pyloroplasty because of esophagitis due to gastroesophageal reflux. On the third postoperative day, he had a chill and temperature elevation to 104°. The only positive physical finding was mild phlebitis at the site of the intracath which had been inserted in the forearm. The infusion catheter was removed, and cultures of its tip grew Klebsiella, as did *all three* blood cultures drawn during the 90 minutes following the chill. Intramuscular penicillin and streptomycin (600,000 u. and 0.5 Gm. respectively, twice daily) which had been administered since the day of operation were discontinued. The physical signs of thrombophlebitis in the left arm became more prominent during the next 48 hours, though no venipunctures were made or infusions given; and his temperature remained elevated. Kanamycin was given on the 6th postoperative day when the blood cultures were reported positive. The fever defervesced within 48 hours, and the remainder of his hospital stay was uneventful.

Comment: Thrombophlebitis was mild at the time of sepsis but worsened rapidly in the 2 days after catheter removal. Although the patient felt better within 24 hours after appropriate antibiotic therapy, it was several days before local signs of phlebitis subsided.

Case 2. A 43-year-old man sustained a fracture-dislocation of the left hip, an anterior dislocation of the right hip, a fracture dislocation of the left elbow, and a fracture of the right humerus and clavicle in an automobile accident. The hip fractures and right shoulder fractures were treated by closed reduction immediately. While recovering and awaiting open reduction of the left elbow fracture, he developed mild tenderness in the left calf and was heparinized with the diagnosis of thrombophlebitis. In spite of adequate anticoagulation, he developed chest pain 2 days later. The diagnosis of pulmonary emboli to the left upper lobe was confirmed by radioactive lung scan and pulmonary angiography, and vena caval ligation was done the same day. Intramuscular penicillin, which had been given since admission, was continued for a week after operation. The postoperative course was satisfactory; and he remained afebrile until the 7th postoperative day, when he had a chill and temperature of 103.4°. In the absence of other physical signs of infection, the subclavian infusion catheter which had been inserted 6 days previously was removed. The catheter tip and three blood cultures taken during the febrile episode grew Pseudomonas. Cephalothin was given when the patient had a chill, but fever continued for 48 hours. At this point, the organism was identified, and colistin was added. Fever subsided within 24 hours, and the subsequent hospital course was satisfactory.

Comment: There were no signs of subclavian thrombophlebitis either before or after the catheter was removed. Whether these signs were suppressed by heparinization (which was continued after vena caval ligation) is not known.

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Case 3. A 72-year-old man was admitted for elective resection of an abdominal aortic aneurysm. The procedure was not complicated, a straight graft being used. Initial convalescence was good; he was ambulatory and taking a full-liquid diet by the 5th postoperative day. Penicillin, methicillin, and streptomycin had been given prophylactically and continued for 5 days after operation. He developed enterocolitis on the 6th postoperative day and, the next morning, had evidence of septicemia. A fulminant, bilateral pneumonitis developed; and ventilatory assistance was necessary. The predominant organism in the sputum was Aerobacter, and kanamycin therapy was instituted. As it was necessary to use controlled ventilation for a prolonged period of time, tracheostomy was performed on the 8th postoperative day; and a subclavian infusion catheter was inserted percutaneously on the 10th day. Though still requiring ventilatory assistance, the patient had become afebrile and continued so until 7 days later, when he had a shaking chill and a temperature rise to 103.4°. When the subclavian catheter was removed, its tip and a blood culture drawn from another site grew Aerogenes, the same organism that persisted in the sputum. He became afebrile again but died a month later of respiratory insufficiency.

Comment: Again, there was no evidence of phlebitis at the infusion site. There was contamination of the dressing about the catheter, as well as the skin in this region, by secretions from the tracheostomy.

Case 4. A 25-year-old man was admitted to the hospital for elective repair of Tetrology of Fallot. A subclavian-pulmonary shunt had been performed at age 8 and was followed by relief of symptoms and relatively normal development. In young adult life, however, he had become progressively more limited in physical activities and desired total correction of the anomaly.

Although the operative findings were double-outlet right ventricle, repair was performed satisfactorily. He was returned to the operating room later in the day because of excessive bleeding from the mediastinum, and a number of small bleeding points were controlled. The endotracheal tube was removed the following morning, and in the first 2 postoperative days he showed excellent progress. Lincomycin was used prophylactically, beginning at the time of operation.

On the 3rd postoperative night, he had shaking chills followed by temperature elevation to 104°. On the basis of a clinical diagnosis of gram negative sepsis, he was given cephalothin, kanamycin, and large doses of steroids. In spite of intensive supportive measures, he died 7 hours later.

Blood cultures taken at the start of the episode grew *E. coli* as did the tip of the one infusion catheter in use at that time. Post-mortem examination showed no evidence of endocardial infection.

Comment: Culture of the pump oxygenator blood at the conclusion of operation had shown no growth. There had been no clinical or radiologic evidence of pneumonitis, and there were no signs of wound infection or phlebitis at the catheter site.

Case 5. A 47-year-old man was admitted to the hospital because of hematemesis which required emergency vagotomy and antrectomy. Except for mild temperature elevation, 100.4° to 102.4° rectally, his initial course was satisfactory. On the 5th postoperative day, he had chills and fever of 105°. Kanamycin therapy was begun, as he had not been taking antibiotics previously. Cultures of the skin around the subclavian infusion catheter, the catheter tip removed from the vein, and the blood all showed *A. aerogenes*. About 24 hours after the chills, the area around the venipuncture site became red, warm, and painful; and large, tender axillary nodes appeared. Although the septic course was reversed quickly, the local inflammatory condition was very troublesome and slow to resolve in spite of the organism's *in vitro* sensitivity to Kanamycin.

Comment: While thrombophlebitis associated with peripheral infusion catheters is not uncommon, such inflammatory response associated with subclavian infusion catheters is unusual. This complication increased the patient's hospital stay by at least a week.

Case 6. A 19-year-old girl with previously diagnosed anorexia nervosa was admitted because of persistent vomiting and weight loss to 58½ pounds. Serum sodium, chloride, and proteins were decreased; the BUN was 35 mg./100 ml. She complained of burning discomfort in the right arm at the site of an infusion catheter from the time it was inserted until it was removed 5 days later after an episode of chills and fever (103.8°). Blood culture and culture of the catheter tip revealed *Citrobacter intermedius*. Although her temperature had returned to normal by the following day, a course of tetracycline therapy was given when results of the blood culture were known.

Comments: Although the patient complained of arm pain for the duration of the infusion, there were never any physical signs of phlebitis. It is noteworthy that the catheter tip culture which was the first to show growth was ignored, the organism being considered a contaminant.

Case 7. A 40-year-old obese executive was admitted to the hospital for treatment of thrombophlebitis manifest by pain and slight swelling of the right calf. The symptoms began while he was diving into a swimming pool 5 days earlier. A continuous infusion of heparin was begun; and the adjunctive measures of bedrest, elevation, and elastic support were used. He had an excellent symptomatic response within the first 24 hours and was convalescing well until the 4th hospital day when he developed fever to 101.4° and chills. Otherwise, he felt well. Blood cultures were drawn, and the forearm infusion catheter was removed, its tip being cultured. Another infusion catheter for heparin administration was inserted in the opposite arm with careful sterile technic. Chest x-rays were normal, as was a radioactive lung scan. The patient remained asymptomatic, but his temperature rose to 103° the following day. By this time Aerobacter was isolated from the blood and the catheter tip, and treatment with doxycycline was begun. On the next day, his 6th hospital day, again his temperature rose to 103° and he developed phlebitis around the infusion catheter which had been inserted 48 hours earlier. The other forearm never became red or tender. Culture of this catheter tip yielded Aerobacter and Pseudomonas. Heparin was administered subcutaneously; ambulation was begun 2 days later; and he was discharged from the hospital on the 14th day. Chloramphenicol had been administered on the basis of sensitivity studies, and a 10-day course was completed after discharge. He has had no recurrence of sepsis or of thrombophlebitis.

Comment: This patient was a young man in good health (except for obesity), and admitting illness was mild. A more seriously ill patient might not have withstood such an episode.

Discussion

Although it is agreed that the incidence of gram negative septicemia has risen sharply in the past decade, this complication is thought to occur in burned patients or in patients with obstructive uropathy, altered immunity, or severe debility. Most of the patients here reported, however, fit none of these categories; and two had not been operated upon! Two who could be considered debilitated, the patient with an aneurysm and one who underwent open-heart surgery, died.

Infusion catheters were the only source of infection in all instances, though the respiratory tract might have been the source in one patient. Less tenable is that the organism was from an endogenous source and was found on the catheter tip because it was a foreign body in the bloodstream.*

Gram negative bacilli are considered fecal flora, and not factors in this type infection. Skin of the hands is not uncommonly a source of these organisms and they are frequently in the respiratory tracts of postoperative patients.[2] Nonetheless, epidemiology of these infections has not been established.

In a recent study of 101 percutaneous infusion catheters removed from randomly selected patients at Indiana University Medical Center, the incidence of positive cultures was 26%. Although staphylococci and streptococci were the most frequent isolates, 20% of the organisms were gram negative bacilli. A striking finding was the lack of correlation between positive cultures and clinical findings of inflammation at the infusion site. This finding, reported by Collins,[1] was borne out in our patients.

Of the 82 catheters removed within 72 hours after insertion, 22 or 27% grew organisms, 84% of the positive cultures, a possible explanation for early clinical infection.

In 1958 Moran[5] reported that topical antibiotic ointment reduced the incidence of infection in incisions for infusions and Wilmore[8] stated that this complication can

* All of the blood cultures were drawn from the arm opposite the side of the infusion.

be prevented by use of subclavian venipuncture and meticulous management of the catheter, even for long-term hyperalimentation. Other studies, however, of peripheral infusions have not confirmed the value of antibiotic ointments and dressings.[6, 9]

Infections due to organisms thought to be non-pathogenic are becoming common in patients with low resistance. An inverse ecologic relationship between some gram positive cocci and gram negative bacilli has been demonstrated[3, 4] and there is a correlation between administration of systemic antibiotics and an increase in strains of Enterobacteriaceae in the stool.[7]

Infusion catheters can be a source of infection and early signs of inflammation at the infusion site are not reliable in diagnosis. A patient who has chills and fever without apparent cause is considered to have infusion catheter sepsis until proven otherwise. Culture of the catheter tip may provide means of selecting appropriate antibiotic therapy.

Summary

Seven patients with gram-negative septicemia from infusion catheters are reported. This entity is an increasing source of morbidity and mortality in hospital patients, and its epidemiology is not understood. These infections cannot be detected early by observation of the infusion site for signs of inflammation.

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References

1. Collins, R. N., Braum, P. A., Zinner, S. H. and Kass, E. H.: Risk of Local and Systemic Infection with Polyethylene Intravenous Catheters. New Eng. J. Med., **279**:340, 1968.
2. Glover, J. L. and Jolly, L.: Gram Negative Colonization of the Respiratory Tract in Hospitalized Patients. In Preparation.
3. Light, I. J., Sutherland, J. M., Cochran, M. L. and Sutorius, J.: Ecologic Relationship between *Staphylococcus aureus* and Pseudomonas in a Nursery Population. New Eng. J. Med., **278**:1243, 1968.
4. Marples, R. R., Fulton, J. E., Leyden, J. and McGinley, K. J.: Effect of Antibiotics on the Nasal Flora in Acne Patients. Arch. Derm., **99**:647, 1969.
5. Moran, J. M., Atwood, R. P. and Rowe, M. I.: A Clinical and Bacteriologic Study of Infections Associated with Venous Cut-downs. New Eng. J. Med., **272**:554, 1965.
6. Norden, C. W.: Application of Antibiotic Ointment to the Site of Venous Catheterization—a Controlled Trial. J. Infect. Dis., **120**:611, 1969.
7. Rose, H. D. and Schreier, H. W.: The Effect of Hospitalization and Antibiotic Therapy on the Gram-Negative Fecal Flora. Amer. J. Med. Sci., **255**:228, 1968.
8. Wilmore, D. W. and Dudrick, S. J.: Safe Long-Term Venous Catheterization. Arch. Surg., **98**:256, 1969.
9. Zinner, S. H., Denny-Brown, B. C., Braun, P., Burke, J. P., Toala, P. and Kass, E. H.: Risk of Infection with Intravenous Indwelling Catheters: Effect of Application of Antibiotic Ointment. J. Infect. Dis., **120**:616, 1969.