The Art and Science of Infusion Nursing

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Oral Parenteral Antimicrobial Therapy Administration in a Homeless Population

ABSTRACT

Outpatient parenteral antimicrobial therapy (OPAT) is increasingly used to treat serious infections. Patients who identify themselves as homeless may receive OPAT less often, and little is known about their treatment outcomes. The purpose of this study was to describe challenges, treatment completion rates, and cost savings of OPAT in homeless patients discharged from a public safety-net hospital.

Key words: bacteremia, cost, homeless, IVDU, OPAT, osteomyelitis, substance abuse

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Outpatient parenteral antimicrobial therapy (OPAT) for treatment of serious infections is an increasing practice after discharge from hospitals in the United States. Not only is OPAT cost-effective, but it also has comparable treatment success rates to inpatient IV antibiotic therapy while minimizing the risk of health care-associated infections.[1] However, not all patients are appropriate for OPAT. The practice guidelines of the Infectious Diseases Society of America state that "the health care team should have knowledge of the patient's home environment prior to OPAT"[2] and that "potential problems, such as the functioning of utilities, safety issues, cleanliness, substance abuse, access to transportation and social strife need to be assessed"[2] before initiation of OPAT. Because of these foreseen barriers, patients who identify themselves as homeless may receive OPAT less often and remain in the hospital for treatment of serious infections. This can place a substantial financial burden on hospitals, particularly safety-net institutions that provide health care to patients regardless of their ability to pay for services.

The hospital in this study has been treating select homeless patients through an established OPAT program for more than 10 years. The purpose of this cohort series is to describe the safety, challenges, treatment completion rates, and estimated cost savings of providing OPAT for homeless patients. To the best of the authors' knowledge, no previous studies have evaluated OPAT administration in homeless patients.

METHODS

Study Setting and Population

This is a retrospective cohort study of homeless patients receiving OPAT for an infection between January 1, 2011, and December 31, 2013, at a public safety-net

hospital in Denver. Patients were eligible for inclusion if they identified themselves as being homeless and were discharged on OPAT to either a respite facility or a hotel or motel. Patients were excluded if they identified themselves as homeless but were discharged to a skilled nursing facility or to a friend's or family member's home, or completed fewer than 2 days of OPAT.

Description of OPAT Program

The hospital's Infectious Diseases (ID) service performs a consultation in all cases before initiating OPAT. Substance abuse, medical adherence, living situation, social supports, and access to transportation are evaluated when determining whether OPAT is appropriate. A decision regarding the appropriateness of OPAT is made on a case-by-case basis by the ID consult service. Discussions are held with the patient regarding expectations for OPAT, and an OPAT contract is signed. Most often, a peripherally inserted central catheter is placed before discharge from the hospital. Patients with underlying renal disease that may warrant eventual dialysis or those with poor venous access have a Hohn catheter placed. Patients are taught basic catheter care during this procedure. Case managers complete the referral to the outpatient infusion pharmacy and ensure temporary housing for patients. Homeless patients are not permitted to administer OPAT to themselves on the street. They must remain in a respite shelter or motel where they will have access to refrigeration. Respite shelters are provided to patients free of charge through Denver's Department of Human Services. Patients who choose to reside in a motel provide their own funding. Antibiotics are delivered by an outpatient infusion company, and a contracted home health agency nurse teaches patients how to administer[2] them. Continuous infusion, prolonged infusion (more than 1 hour), and intravenous (IV) push medications are used according to the most appropriate antibiotic regimen, the stability of the medication, and patient or provider preferences. Follow-up ID appointments are scheduled within 1 week of hospital discharge. Patients are instructed to notify the ID provider of any problems or concerns regarding their antibiotics or catheter before discharge. They are provided with office and clinic contact numbers in the event that they have questions. In an emergency, it is recommended that they go to the emergency department for evaluation.

At weekly follow-up visits, patients are seen by a team that includes nursing and ID providers. The vascular access device is cared for, labs are drawn to evaluate for antibiotic toxicity, and the patient is evaluated for comprehension of safe administration, clinical improvement, and complications. Outcomes are tracked in a clinical database.

Data Collection

Data were collected retrospectively from the electronic medical record. Variables of interest included age, gender, substance abuse, type of infection, antibiotic regimen, length of hospitalization, 30-day hospital readmission rate, central catheter-related complications, recommended duration of antibiotics, duration of OPAT, and duration of total antibiotics. The reason for discontinuation of OPAT was noted.

Definitions

Treatment completion was defined as completion of the recommended course of antibiotics. Patients who completed a full IV antibiotic course or were changed to highly bioavailable oral antibiotics for patient or provider preference were defined as *completed therapy*.[3] *Unsuccessful treatment* was defined as discontinuation of treatment for a grade 3/4 adverse drug event[4]; catheter-related complication; or social concern leading to nonadherence to the OPAT expectations, including inability to attend follow-up visits, substance abuse, or leaving the hotel, motel, or respite shelter without another stable housing arrangement.

Cost-Saving Analysis

To estimate cost savings, the expected outpatient costs were subtracted from the expected inpatient costs calculated over the median duration of OPAT. Outpatient costs included home nursing care, central catheter solutions and IV antibiotics, outpatient clinic visits, and laboratory studies. Inpatient costs included the bed charge on the medical-surgical unit, laboratory studies, and IV antibiotics. Cost estimates were based on information provided by a contracting outpatient pharmacy, a contracting home nursing company, and the hospital's utilization management department, and the hospital's laboratory.

Statistical Analysis

The primary outcome of the study was completion of the recommended duration of treatment with either IV antibiotics or IV antibiotics followed by highly bioavailable oral antibiotics. Secondary outcomes included the presence of social concerns that potentially interfered with safe OPAT, such as grade 3/4 adverse drug events, catheter-related complications, and the estimated cost of OPAT compared with continued hospitalization for the duration of IV treatment. Descriptive statistics were used to characterize the population. The *t* test of means, χ^2 test of association, and Fisher exact tests were used

to determine bivariate relationships between the patient and treatment characteristics. Statistical analyses were performed using SAS version 9.3 (SAS Institute, Cary, NC). This study was approved by the Colorado Multiple Institutional Review Board.

RESULTS

Forty-three homeless patients were treated with OPAT during the study. Thirty-nine patients were male (90.7%). The median age of patients was 52 years (interquartile range [IQR] 48.7-58.6). The most common infections treated were bacteremia (53.5%), followed by long-bone osteomyelitis (20.9%), osteomyelitis of the foot (20.9%), complicated urinary tract infections (13.9%), septic arthritis (9.3%), pulmonary infections (4.6%), and endocarditis (2.3%). *Staphylococcus aureus* (64.2%) and *Streptococcus* species (16.7%) were the most common pathogens. Vancomycin (45.8%) and cefazolin (25.0%) were the most frequently prescribed antibiotics. The median duration of OPAT was 23 days (IQR 10-35). The median number of days by which patients were short of completing the recommended length of treatment was 0 days (IQR 0-1).

Thirty-three (77%) patients completed treatment without any documented social concerns or catheter-related complications. Seven patients had documented social concerns (16%). Six patients were able to complete therapy with transition to a highly bioavailable option. One patient was stopped short of recommended treatment length, and, therefore, treatment was considered incomplete. Missing appointments was the most common social concern (11%), followed by difficulty keeping secure housing (9%). Two patients had to stop OPAT because they lost their temporary housing, but both were able to complete treatment with a highly bioavailable oral option. Two patients were found to have active substance abuse issues during their treatment course. One patient was able to complete therapy on an oral option, while the other patient stopped therapy 1 week short of initial recommended treatment. Social concerns were not associated with having a history of current or active substance abuse. The probability of social failure also was not affected by whether the patient was discharged to a respite shelter versus a hotel or motel, gender, age, or length of hospitalization. Most patients with a documented social concern completed treatment (Figure 1).

Catheter-related complications were uncommon (5%). One patient lost access because the vascular access device fell out, and 1 patient required catheter removal because of occlusion. All patients who had a catheter-related complication were transitioned to oral therapy and completed treatment. No catheter-related complications required hospital readmission, and no central line-associated bloodstream infections were

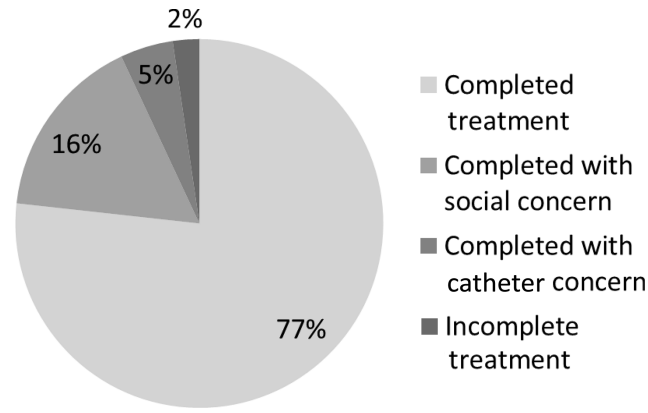

Figure 1 Treatment success of OPAT in homeless patients. *Abbreviation: OPAT, outpatient parenteral antimicrobial therapy.*

reported. Any increased likelihood of catheter failure associated with a reported history of or current substance abuse was not shown (Figure 1).

The majority of patients did not experience any side effects (78.5%). Eight patients were readmitted within 30 days. One (2.1%) was rehospitalized for a grade 3/4 adverse event (acute kidney injury) and subsequently regained full renal function. Three patients developed worsening infection (7.1%). Three patients were readmitted with diagnoses unrelated to OPAT or the infectious process.

The median duration of OPAT was 23 days (IQR 10-35). The estimated cost of OPAT per patient over a 23-day period was $2150. In contrast, the projected cost of keeping the patient in the hospital for the same length of time was $47 720 on vancomycin and $47 523 on cefazolin (Table 1). The estimated cost savings of OPAT were $45 970 to $46 164 per patient.

DISCUSSION

The majority of patients in the study completed treatment without incident. These data are similar to OPAT success rates previously reported in the literature of 70% to 85%.[1,5-11] Risk of complications was low, with only 1 patient with a reported grade 3/4 adverse drug event. A significant cost savings was demonstrated by using OPAT rather than keeping patients hospitalized, which was consistent with previous studies reported.[1] Mohammadi et al estimated that OPAT use saved their facility approximately $4 million a year.[12] Additionally, a study by Yang et al estimated that the cost of OPAT was about half that of inpatient stay, without any difference in outcome between the groups.[13]

It was hypothesized that patients with a history of active or previous substance abuse would be more likely to discontinue OPAT early. Surprisingly, this was not the case. It is suspected that this unexpected finding is attributable to selection bias on the part of the ID consult service, which initially evaluates patients' candidacy

TABLE 1

Estimated Cost Savings of Outpatient Parenteral Antimicrobial Therapy Versus Hospitalization for Duration of Intravenous Antibiotics

Variable	Cost per Unit × Number of Units	Total Cost
Outpatient parenteral antimicrobial therapy		
Home nursing care	$120 × 3	$360
Central catheter solutions and IV antibiotics	$52 × 23	$1196
Laboratory studies	$8 × 3	$24
Clinic visits	$190 × 3	$570
Total		$2150
Hospitalization for duration of IV antibiotics		
Bed charge on medical-surgical unit	$2062.55 × 23	$47 438.65
IV antibiotics		
Vancomycin 3.5 g	$12.25 × 23	$281.75
Cefazolin 6 g	$3.64 × 23	$83.72
Laboratory studies	$8.00 × 3	$24.00
Total		$47 523-$47 720

Abbreviation: IV, intravenous.

for OPAT. No formal criteria currently exist for making this determination; however, the success of this cohort indicates that individuals and institutions may benefit from the development of formal OPAT candidacy criteria for homeless populations.

The strength of the study is that it is the first study to describe successful OPAT in a marginalized patient population and demonstrate significant potential cost savings. Weaknesses of the study include the cohort design and small number of patients. In addition, the study does not fully reflect the entire population of homeless patients. As discussed previously, there is selection bias on behalf of the ID provider when the initial determination of whether the patient is appropriate for OPAT is made.

CONCLUSION

Treating select homeless patients with OPAT through an established program can be safe and cost-effective. Data from the study support good-practice recommendations that having a dedicated OPAT program in place with close monitoring of patients increases the likelihood of success, even in high-risk patients. Institutions should examine whether this could be a useful practice for their patient populations.

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