Background

Many fractures are managed using orthopedic fixation hardware to provide fracture stabilization, maintain fracture reduction, and promote adequate bone healing. One of the most significant risks of this approach, however, is the development of orthopedic hardware-related osteomyelitis (OHRO). 1,9 OHRO is relatively uncommon but may be associated with decreased bone healing/nonunion, increased morbidity, and significant healthcare costs, due to the need for prolonged antimicrobial and additional surgical intervention. 1,9

The management of OHRO depends on patient- fracture/hardware- and infection-related factors, and may include surgical intervention (e.g., debridement, hardware removal, hardware revision, etc.) and antimicrobial therapy that often involves a prolonged course of parenteral antibiotics followed by oral (PO) suppressive therapy some cases, until the hardware can be removed. 2,3

OPAT refers to the practice of administering parenteral antimicrobial therapy at settings outside the hospital. The increased use of OPAT in recent years for complicated infections has been attributed to the availability of antibiotics that can be administered once or twice daily, the technological advances in vascular access devices and infusion pumps, the increased acceptance of OPAT by patients and healthcare workers, and the potential cost savings due to reductions in hospital lengths of stay. 3 To date, few studies have evaluated the use of OPAT for the treatment of OHRO; therefore, additional information is needed to evaluate the efficacy and safety of this form of care.

Methods

The electronic medical records of adult patients (≥ 18 years of age) receiving OPAT for OHRO between July 1, 2010, and March 1, 2016, at Eskenazi Health (EH), and at Parnassus (PO) were retrospectively reviewed. We included patients with infections of orthopedic hardware (OHRO), and excluded patients with infections of non-orthopedic devices, as well as patients who received OPAT for infections caused by MRSA, vancomycin-resistant Enterococcus (VRE), and Candida species.

The outcome data for each patient was collected for 24 months following OPAT completion, and was classified as cure or failure according to the following definitions applied during data analysis:

- **Cure** = Completion of OPAT course with lack of clinical signs/symptoms of infection. CRP < 5 mg/L, absence of radiologic signs of infection with hardware removal as planned, negative intraoperative cultures
- **Failure** = Persistent clinical/laboratory signs of infection during or at the end of OPAT, unanticipated repeat surgery, isolation of new organism from removed hardware, or extension of OPAT due to continued infection

Safety of OPAT was evaluated through adverse drug event (ADE) and line complication (LC) monitoring. Readmission rates due to OPAT-related ADE and LC were also recorded.

The primary outcome was the number of patients who achieved clinical cure; secondary outcomes included the number of patients with adverse events or line complications during OPAT, compliance rates with PO suppression, and the risk factors for treatment failure.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N (%)</th>
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<tbody>
<tr>
<td>Age (years, mean ± SD)</td>
<td>50.5 ± 13.2</td>
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<tr>
<td>Gender</td>
<td>Male 30 (57%), Female 23 (43%)</td>
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<tr>
<td>Ethnicity</td>
<td>Caucasian 33 (62%), African American 18 (34%), Hispanic 2 (4%)</td>
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<tr>
<td>Social History/Comorbidities</td>
<td>Alcohol abuse 15 (28%), Tobacco Use 31 (58%), Iliotibial Band Syndrome 17 (32%), Diabetes 14 (26%)</td>
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<tr>
<td>OPAT Site of Care</td>
<td>Home 23 (43%), SNF 25 (47%), Hemodialysis 2 (4%), Other 3 (6%)</td>
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Table 1: Clinical Indications for OPAT

Of the 53 patients with OHRO who received OPAT during the study period, 2 were excluded from the clinical outcome and safety analysis due to refusal of OPAT (n=1) and transition to comfort care only (n=1). Thirty of 51 (99%) patients with OHRO received OPAT in the presence of retained hardware. Forty-three of 51 (47%) patients achieved clinical cure while 53 (99%) experienced a treatment failure due to lengthening of OPAT course due to continued features of infection noted during OPAT clinic visits (71, 44%), the need for unplanned surgery (16, 37%), and 51% due to the course of OPAT, and recurrence of infection after OPAT (31, 19%). Five patients (31%) experienced early treatment failure requiring hardware removal before the completion of OPAT. Of the remaining 25 patients who received OPAT in the presence of retained hardware, 23 (92%) were prescribed chronic oral antibiotic suppression at the completion of OPAT until hardware removal was completed. Although compliance with oral suppressive therapy could not be determined for every patient, treatment failure was noted in 3 patients with retained hardware who were noncompliant with their prescribed PO suppressive antibiotic regimen.

Twenty one of 51 (41%) patients with OHRO received OPAT after hardware removal. Sixteen of 21 (76%) patients who received OPAT after hardware removal experienced clinical cure while 5 (24%) patients experienced clinical failure. All 5 patients categorized as treatment failure required extension of OPAT for 2 to 3 weeks due to continued features of infection noted during OPAT clinic visits.

The mean duration of OPAT was 41.5 ± 6.7 days (range 14 to 56 days). Vancomycin (alone or in combination) was the most commonly prescribed antibiotic used during OPAT (18/53, 34%), followed by cefazolin (18/53, 32%), linezolid/vancomycin (8/53, 15%), ceftriaxone (6/53, 9%), ertapenem (2/53, 4%), meropenem (2/53, 4%), ceftepime (2/53, 4%), and other (8/53, 15%) including piperacillin/tazobactam, aztreonam, cefazolin, oral (PO) lincomycin, PO metronidazole, PO ciprofloxacin, PO levofloxacin, PO rifampin, and PO fluconazole. Antibiotics with good oral bioavailability were administered PO as part of a combination regimen for OPAT.

Conclusion

OPAT is a viable treatment option for OHRO when utilized in appropriate patients. Patients with retained hardware and noncompliance with oral suppressive therapy appear to be at risk for treatment failure. Further study is needed to validate these and other potential risk factors for treatment failure.

Author Disclosure and Contact Info

The authors do not have any conflicts to disclose. Contact Cole Beeler colebeeler@iupui.edu or Sharon Erdman serdman@iupui.edu

References