The Effect of Silver on the Reduction of Pin-Tract Infections in Patients Undergoing Hand Surgery: A Retrospective Comparison

M Shahbaz, P N Chotai, C I Anderson, J H Clarkson

Citation

Abstract
Background:
Kirschner wires (K-wires) are commonly used in the management of hand and wrist fractures. Pin tract infections are a common and recognized complication associated with the use of percutaneous K-wires. The administration of antibiotic therapy and pin removal resolves a majority of these infections. Despite this, there is a risk of osteomyelitis, septic arthritis, flexor sheath infection and toxic shock syndrome if these treatment approaches are not successful. Additionally, managing mild pin tract infection is painful for the patient and adds cost to their care. To reduce the number of pin tract infections a variety of post-operative pin-site care methods have been developed; although, the scientific community has not come to a consensus in terms of the best method. Silver-based dressings can have a potential role in preventing such infections; however, there is a lack of objective and relevant clinical data. In order to assess the effectiveness of a silver-based dressing, the pin-tract dressing regimen was modified to include a topical silver based product upon the first signs of a pin-tract infection. We analyzed the effects of a silver impregnated non-adherent contact mesh combined with a hydrocolloid dressing in all patients undergoing percutaneous fixation of hand and wrist fractures using K-wires.

Methods:
Through the utilization of a retrospective analysis of electronic medical records and well-defined inclusion criteria, participants were selected into the study. Only participants who met all of the following inclusion criteria were selected: (1) Patients having received a K-wire surgery due to a hand/wrist fracture; and (2) Surgery occurred during the study period: October 2010 to September 2012. Exclusion criteria included (1) Open fractures; (2) Concomitant local soft tissue injury; (3) Buried K-wires; and (4) Onset of infection prior to the first post-operative visit. An IRB application involving human subjects was filed and accepted by the Institutional Review Board and Ethics Committee of the MSU.

Results:
A total of 142 K-wires (76 patients) were placed for percutaneous fixation of fractures around the hand and wrist during the study period, October 2010 to September 2012. For post-operative pin-site care, patients treated prior to September 2011 received a non-silver based dressing (Group Ag-, N1=58 K-wires); whereas, patients treated after October 2011 received a silver-based dressing (Group Ag+, N2=84 K-wires). The rate of infection in Group Ag- was 10/58 K-wires (17.24%); whereas, the infection rate in Group Ag+ was 3/84 K-wires (3.57%). The relative risk reduction for the development of infections following Kirschner wire placement after the use of silver-based dressing was 78%. The decreased risk of infection in the silver-based dressing group was found to be statistically significant (p ≤ 0.05) using Fisher’s Exact Test. Lastly, the number of patients required to prevent one event of a pin-tract infection was determined to be 6.

Conclusion:
Based on our findings, we have concluded that the silver-based dressing system is an effective method in reducing the incidence of infections in percutaneously placed pins or K-wires in fixation of fractures around the hand and wrist.
INTRODUCTION

Kirschner wires (K-wires) are utilized in the management and treatment of unstable hand and wrist fractures. Pin tract infections are a common and recognized complication associated with the percutaneous fixation of hand and wrist fractures using K-wires. One technique used to minimize pin tract infections involves wire burial. Even though this approach minimizes pin-tract infections, there is an increased cost and patient discomfort associated with having the patient undergo a second surgery to remove the wire. In procedures leaving the wire exposed, there is an increased risk of infections and the common use of antibiotic therapy and pin removal resolves a majority of these infections; however, patients may suffer from osteomyelitis, septic arthritis, flexor sheath infection, and toxic shock syndrome if these treatment approaches are not effective.

For those wires that are exposed percutaneously, a variety of post-operative pin-site care methods have been developed (i.e., hydrogen peroxide or saline washes, prophylactic antibiotic treatment). Currently, there is a debate in the literature regarding the most effective and appropriate postoperative care of K-wires. Evidence has shown that silver-based dressings can have a potential role in preventing such infections; however, there is a lack of objective and relevant clinical data. In order to assess the effectiveness of a silver-based dressing, we omitted the hydrogen peroxide wash from our patient care and substituted it with a prophylactic combination treatment of a silver impregnated non-adherent contact mesh combined with a hydrocolloid dressing.

METHODS

The occurrence of pin-tract infections was recorded following a review of the medical records of patients that presented to the Hand Clinic at the Department of Surgery, Michigan State University College of Human Medicine for treatment of hand or wrist fractures during the period October 2010 through September 2011. During October 2011, an intervention to reduce the incidence of post-operative K-wire infections was introduced. The incidence of infection for patients seen between October 2011 and September 2012 were compared to the pre-intervention group. Those patients with the diagnosis of open fractures, concomitant local soft tissue injury, buried K-wires and the onset of infection prior to the first post-operative visit were excluded from the study.

Patients seen during the pre-intervention phase were instructed to maintain clean hand hygiene and cleanse the K-wire incision site with hydrogen peroxide daily. Pin-site care for all patients undergoing percutaneous fixation of hand and wrist fractures using K-wires in the post intervention group involved a prophylactic infection prevention bundle that included a silver impregnated non-adherent contact mesh combined with a hydrocolloid dressing.

A data collection tool was developed that included obtaining patient demographics (age, gender), date of injury, number of days between injury and operative procedure, the number of K-wires placed, and the type of site dressing applied. Post-operatively we recorded the occurrence of any observed sign of infection, the use of antibiotic therapy to treat the complication and the date K-wires were removed from the hand. The Michigan State University Institutional Review Board approved the study. Data were analyzed using descriptive statistics and Fisher exact (p < 0.05). Further, we calculated the relative risk, relative risk reduction, and the number needed to treat utilizing a 2x2 table.

RESULTS

The medical records of 76 patients who underwent the insertion of 142 K-wires were reviewed. Thirty-three patients were included in the pre-intervention phase and 43 patients were included in the post intervention phase (Table 1). Seventy percent of the patient population was males between the ages 37 and 44 years, with an average of 2 percutaneously placed wires. The rate of infection in the silver negative group was 10/58 K-wires (17.2%, n = 10); whereas, the infection rate in silver positive group was 3/84 K-wires (3.6%, n = 3). Figure 1.

The incidence of infection in the silver-based dressing group was found to be statistically significant (p = 0.013) when compared to the pre-intervention group. Each patient diagnosed with a K-wire infection was treated with a 10-day course of antibiotics and pin removal. None required return to the operating room.

The risk of developing an infection following a K-wire insertion procedure is less in those patients who were treated with a silver-based dressing when compared to those simply using a hydrogen peroxide wash. The relative risk reduction for the development of infections following K-wire placement after the use of silver-based dressing was 78%. For every six individuals treated with the silver-based dressing, one case of infection associated with the k-wire
procedure is prevented.

DISCUSSION

Our study focused primarily on the effects of a silver impregnated non-adherent contact mesh combined with hydrocolloid dressing in all patients undergoing percutaneous fixation of hand and wrist fractures using K-wires. In line with our study findings, we were able to significantly reduce the incidence of post-operative infection in patients with percutaneous K-wire insertions with the use of silver impregnated non-adherent contact mesh combined with hydrocolloid dressing. Overall, we identified a 78% reduction in pin tract infection rates in this patient population.

It is important to note that the results of our study concur with a similar study conducted by Bhattacharyya and Bradley in 2006, in which nanocrystalline silver-release dressing reduced the infection rate in the post-operative management of K-wires. In their study conducted in 2004, Hargreaves et al. it was determined that K-wire burial significantly decreases infection rates; however, there is an increased level of immobility and the need to return to the operating room for pin removal. We believe that we have identified a reasonable approach to reduce the incidence of infection without further loss of mobility and the need to return to the operating room for pin removal. In summary, we have concluded that the a silver impregnated non-adherent contact mesh combined with hydrocolloid dressing is an effective method in reducing the incidence of infections in percutaneously placed pins or K-wires in fixation of fractures around the hand and wrist.

STUDY LIMITATIONS

We acknowledge the limitations of this study. First, our study is limited since we conducted a retrospective data analysis of a small sub-population of patients having undergone a K-wire surgery at our clinic. We recognize that the sample size of the study is not large and that the results may not be applicable to the general population (external validity). We also recognize that retrospective case control studies may suffer from recall bias and confounding variables; however, we utilized the medical records of patients to minimize these factors. Even though we have concluded that the study findings are significant, it will be of clinical importance to conduct a similar study on a broader patient population undergoing similar procedures. In summary, future prospective trials in multiple venues may provide further evidence of the efficacy of this approach.

Table 1

<table>
<thead>
<tr>
<th></th>
<th>Pre-intervention (n = 39)</th>
<th>Post-intervention (n = 43)</th>
</tr>
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<tbody>
<tr>
<td>Average age</td>
<td>44.9 yrs</td>
<td>37.6 yrs</td>
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<td>Age range</td>
<td>19-35 yrs</td>
<td>18-45 yrs</td>
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<tr>
<td>No. of Males</td>
<td>22 (57%)</td>
<td>31 (72%)</td>
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<tr>
<td>No. of K-wires placed</td>
<td>58</td>
<td>84</td>
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<td>Avg. No. of days to OR</td>
<td>15 days</td>
<td>11 days</td>
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<tr>
<td>Avg. No. of days to K-wire removal</td>
<td>32.2 days</td>
<td>32.3 days</td>
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<tr>
<td>No. of K-wire infections</td>
<td>10</td>
<td>3</td>
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</tbody>
</table>

Figure 1

Infection rates among the pre-intervention and post-intervention groups.

References

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