Administration of antibiotic prophylaxis in hip replacement surgery: an evaluation after introduction of new guidelines

Joakim Dinh Truong

Prosjektoppgave ved det medisinske fakultet
Veileder:
Marianne Westberg, seksjonsleder, overlege PhD, seksjon for protesekirurgi, ortopedisk avdeling Ullevål, Oslo universitetssykehus
Jan Erik Madsen, professor UiO, overlege seksjon for ortopedisk traumatologi, ortopedisk avdeling Ullevål, Oslo Universitetssykehus

University of Oslo
2018
Copyright Joakim Dinh Truong

2018

Administration of antibiotic prophylaxis in hip replacement surgery: an evaluation after introduction of new guidelines

Joakim Dinh Truong

http://www.duo.uio.no

Trykk: Reprosentralen, Universitetet i Oslo
Abstract

Background and purpose: Surgical site infection is a feared complication leading to increased morbidity, reoperations and increased length of hospital stay. Prophylactic antibiotics is used to prevent surgical site infection and the timing of administration is crucial for optimal effect. In 2013 there was implemented new guidelines within “safe surgery” regarding timing of antibiotic prophylaxis in surgery. The adherence to these new guidelines has never been validated.

Methods: The timing of administration of prophylactic antibiotic in relation to start of surgery was recorded in 345 cases operated with a hip arthroplasty for either dislocated femoral neck fracture or osteoarthritis at Oslo University Hospital Ullevål in 2012 and 2016.

Results: There was a significant difference in timing of prophylaxis between patients operated for acute dislocated femoral neck fractures in 2012 versus 2016 after the new guidelines were implemented. In 2012, 27% of the patients were given antibiotics within the recommend time frame, while in 2016, 38% were given antibiotics within the recommended time frame. Of 141 cases electively operated for osteoarthritis, 89 (63%) were given prophylactic antibiotics within the recommended time frame.

Conclusion/interpretation: The improvement of adequate timing of prophylactic antibiotics indicate that use of simple checklist improve adherence to guidelines. But, despite improvement, there are still to many patients getting preoperative antibiotic prophylaxis inadequately. In addition, there is a significant differences between patients undergoing elective and acute surgery in 2016. Focus on routines must continuously be sharpened.
Table of contents

1 Introduction ........................................................................................................................................... 5
2 Subjects and methods ......................................................................................................................... 7
3 Results ................................................................................................................................................ 8
4 Discussion ........................................................................................................................................... 12
References ............................................................................................................................................... 14

Abbreviations:
FNF Femoral neck fracture
HA Hemiarthroplasty
THA Total hip arthroplasty
1 Introduction

Surgical site infection is a feared complication leading to increased morbidity, reoperations and increased length of hospital stay. In elderly, the mortality rate is substantially increased as well.

The effectiveness of antibiotic prophylaxis in patients undergoing total hip and total knee replacement was evaluated in a systematic review in 2008 involving 26 studies, including randomizing clinical trials (1). This review showed that the absolute risk of wound infection was reduced by 8% with antibiotic prophylaxis and the relative risk by 81% compared with no antibiotic prophylaxis. Further, it concluded that antibiotic prophylaxis should be routinely given in joint replacement surgery.

It is important that antibiotics is given adequately to achieve desired effect, or to give any effect at all. To achieve proven effectiveness, it is important to maintain a high peak tissue concentration at the site of the wound from start of the incision to end of surgery (2, 3). To achieve desired high peak tissue concentration at the site of wound, for most surgery procedures it is enough with a single dose antibiotics given 30 minutes before incision (4, 5). Due to associations with increased risk of infectious complications, there are indications that prophylactic antibiotics should not be administered earlier than 60 minutes before incision (6, 7).

In a study from the University of Lund in 2009, they showed that antibiotic prophylaxis were given inadequately in surprisingly many cases, and that routines in joint surgery should be improved (8). A goal could be a simple checklist.

The World Health Organization (WHO) published guidelines for safe surgery in 2008 as a tool to reduce the occurrence of injuries and complications associated with surgical procedures (9). Eight hospitals implemented the usage of a 19-item safety surgery checklist as pilot sites in the Safe Surgery Save Life Program (10). A prospective trial at the 8 pilot sites showed that introduction of surgical safety checklist reduced postoperative complication and mortality significantly, and antibiotic administration prior to surgical incision within 60 minutes was improved from 56% to 83% (11).
The Norwegian directorate of health started the campaign “in safe hands” through its patient security program to promote the usage of WHO surgical safety checklist (10, 12). Surgical safety checklist has been implemented at Norwegian hospitals with variable degree of success. Different strategies for successful implementation of surgical checklists has been suggested (13).

During 2012, the Orthopedic department at Oslo university hospital Ullevål introduced new guidelines “safe surgery” including administration of antibiotic prophylaxis. In 2013, the Norwegian Directorate of Health introduced new leading guidelines regarding timing of antibiotic prophylaxis in surgery, and the guideline were implemented the same year. According to the guidelines, cephalothin (2grams) should be given in 4 doses every 90. minutes, and the first dose should be given 30-60 minutes prior to incision. There was an increased focus on administration of antibiotic prophylaxis in the period of implementation of new guidelines. The goal of this study is to validate the adherence to these new guidelines.
2 Subjects and methods

Data were collected retrospectively from a total of 345 patients operated at the orthopedic department, Oslo University Hospital Ullevål in the years 2012 and 2016.

Data was collected from three groups of patients for comparison:
- Patients with acute femoral neck fracture operated with total hip arthroplasty (THA) or hemiarthroplasty in 2012. Patients were identified from the local fracture register (referred to as FNF12).
- Patients with acute femoral neck fracture operated with a THA or a hemiarthroplasty in 2016. Patients were identified from the local fracture register (referred to as FNF16).
- Patients operated electively with a THA due to osteoarthritis in 2016 (referred to as A16). Patients identified from the local arthroplasty register.

Data regarding patients operated electively with THA due to osteoarthritis in 2012 were not available and is therefore not included in this study.

The data was anonymously obtained from the anesthetic journals in the local journal system (DIPS). In the anesthesia records, information was obtained regarding the start of the operation (incision), the end of the operation, and the time of the 1st and 2nd dose of antibiotics.

Statistical analysis was performed using SPSS for MAC, version 23. Fisher’s exact test was used to compare categorical variables, and t-tests were used for continuous variables. A significance level of 5% was chosen.
3 Results

FNF12 consisted of 112 patients, all operated for an acute dislocated femoral neck fracture. 17 patients (15%) were operated with a total hip arthroplasty (THA) and 95 (85%) with a hemiarthroplasty (HA). In 31 (27%) cases, the antibiotic prophylaxis was administered 30 minutes before surgery or earlier, while 45 (40%) were administered either 15 minutes before or even after start of surgery. The mean time for given antibiotic prophylaxis was 20 minutes before the incision started, and ranged from 68 minutes before incision to 37 minutes after the incision was made.

FNF16 consisted of 92 patients operated for an acute dislocated femoral neck fracture. 14 (15%) were operated with a THA and 78 (85%) with a HA. In 35 cases (38%), the antibiotic prophylaxis was administered 30 minutes before start of surgery or earlier, while 16 (17%) were administered either 15 minutes before, or at induction of surgery. The mean time for administration of the antibiotic prophylaxis was 26 minutes before the incision started and ranged from 67 minutes before incision to the same time the incision was made.

A16 consisted of 141 patients, electively operated because of osteoarthrosis. 139 (99%) patients were operated with a THA and 2 (1%) with a HA. In 89 (63%) cases, the antibiotic prophylaxis was administered 30 minutes before start of surgery or earlier, while 11 (8%) were administered 15 minutes before or after start of surgery. The mean time for given antibiotic prophylaxis was 35 minutes before start of surgery and ranged from 74 minutes before incision to 60 minutes after start of surgery.

There was a significant difference between FNF12 and FNF16, 20 minutes versus 26 minutes ($p<0.01$). The preoperative antibiotic prophylaxis in FNF16 was given mean 6 minutes earlier than of FNF2012 after the implementation of surgical checklist. The amount of patients getting the prophylaxis less than 30 minutes prior to incision was reduced from 81/112 (72%) to 57/92 (62%) ($p=0.002$).
There was also a significant difference between FNF16 and A16, 26 minutes versus 35 minutes \((p<0.001)\). In A16, preoperative antibiotic prophylaxis was administrated mean 9 minutes earlier than FNF16.

Table 1: Overview

<table>
<thead>
<tr>
<th></th>
<th>(^a)THA</th>
<th>(^b)HA</th>
<th>(^c)Administration of prophylactic antibiotic</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>N</td>
<td>&lt;15 min</td>
<td>15-30 min</td>
</tr>
<tr>
<td>FNF12 (n=112)</td>
<td>17</td>
<td>95</td>
<td>37</td>
<td>44</td>
</tr>
<tr>
<td>FNF16 (n=92)</td>
<td>14</td>
<td>78</td>
<td>14</td>
<td>43</td>
</tr>
<tr>
<td>A16 (n=141)</td>
<td>2</td>
<td>89</td>
<td>9</td>
<td>43</td>
</tr>
</tbody>
</table>

\(^a\)THA (Total hip arthroplasty)

\(^b\)HA (Hemiarthroplasty)

\(^c\)The timing of administration of prophylactic antibiotic in relation to the start of surgery
**Figure 1.** The timing of administration of prophylactic antibiotic in relation to start of surgery for dislocated femoral neck fractures. Zero represents start of surgery. Green bars represent acceptable timing and red bars inadequate timing of given antibiotic.
Figure 2. The timing of administration of prophylactic antibiotic in electively operated hip arthroplasties. Zero represent start of surgery. Green bars represent acceptable timing and red bars inadequate timing of given antibiotic.
4 Discussion

After the Norwegian Directorate of Health introduced new leading guidelines regarding “safe surgery”, implemented at Oslo university Hospital in 2013, timing of administration of antibiotic prophylaxis in hip replacement surgery has clearly improved. Findings in this study show that adequate timing of administration of antibiotic prophylaxis improved from 27% to 37% in patients operated for an acute dislocated femoral neck fracture in 2012 versus 2016. The improvement was especially found in the period 0-30 minutes prior to surgery.

By comparison, in 92 patients operated for an acute dislocated femoral neck fracture in 2016, 35 (38%) the antibiotic prophylaxis was adequately administered versus 89/141 (63%) in patients electively operated for osteoarthritis in the same year.

In a study from the University of Lund in 2009, they showed that antibiotic prophylaxis was given inadequately in surprisingly many cases, and that this inadequate timing of administration of prophylactic antibiotic indicate a fall in standards due to aseptic and antiseptic routine in arthroplasty surgery. Further, they suggested that a checklist may contribute to keep standards and strict regime to ensure safe surgery by expected standards (8).

This study shows that the use of simple checklists to ensure safe surgery works. Checklists improves the adherence to guidelines. A higher percentage of patients operated for femoral neck fracture got adequate timing of administration of prophylactic antibiotic after implementation of new guidelines. But there are still too many patients getting preoperative antibiotic prophylaxis inadequately, and the problem is that the prophylaxis is not administered early enough to ensure peak concentration at the time of incision. Focus on routines must continuously be sharpened. Patients operated electively for hip replacement in 2016 had a higher rate of adequate timing of prophylactic antibiotic than patients operated acute. Elective surgery may have better adherence to guidelines due to lower variety of personnel, surgery during daytime and planned standard procedures. Acute surgery take place at all hours with a variety of personnel, both surgeons and anesthesia personnel, that may
not have much experience or daily involvement in joint replacement surgery. Emergency operations may often be more hectic which may lead to poorer adherence to guidelines.

In conclusion, implementation of checklist and broad focus on guidelines gives better timing of administration of antibiotic prophylaxis. Despite improvement, there are still too many patients getting preoperative antibiotic prophylaxis inadequately. It is important to continuously evaluate adherence to guidelines to ensure the surgical safety by keeping up standards of strict aseptic routines in arthroplasty surgery, as in all surgery.
References