Short-term complication rate following orthopedic surgery in a tertiary care center in Argentina

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Abstract -- Introduction: Registration of adverse events following orthopedic surgery has a critical role in patient safety and has received increasing attention. The purpose of this study was to determine the prevalence and severity of postoperative complications in the department of orthopedic unit in a tertiary hospital.

Methods: A retrospective review from the postoperative complication registry of a cohort of consecutive patients operated in the department of orthopedic surgery from May 2015 to June 2016 was performed. Short-term complications (3 months after surgery), age gender, types of surgery (elective, scheduled urgency, non-scheduled urgency, and emergency), operative time, surgical start time (morning, afternoon or evening), American Society of Anesthesiologists score and surgeon’s experience were assessed. Complications were classified based on their severity according to Dindo-Clavien system: Grade I complications do not require alterations in the postoperative course or additional treatment; Grade II complications require pharmacological treatment; Grade III require surgical, endoscopic, or radiological interventions without (IIIa) or with (IIIb) general anesthesia; Grade IV are life-threatening with single (IVa) or multi-organ (IVb) dysfunction(s), and require ICU management; and Grade V result in death of the patient. Complications were further classified in minor (Dindo I, II, IIIa) and major (Dindo IIIb, IVa, IVb and V), according to clinical severity.

Results: 1960 surgeries were performed. The overall 90-day complication rate was 12.7% (249/1960). Twenty-three complications (9.2 %) were type I, 159 (63.8%) type II, 9 (3.6%) type IIIa, 42 (16.8%) type IIIb, 7 (2.8%) type IVa and 9 (3.6%) were grade V according to Dindo-Clavien classification (DCC). The most frequent complication was anemia that required blood transfusion (27%) followed by wound infection (15.6%) and urinary tract infection (6%).

Discussion: The overall complication rate after orthopedic surgery in our department was 12.7%. The implementation of the DCC following orthopedic surgery was an important tool to measure the standard of care.

Key words: Complication, Orthopedic surgery, Clavien-Dindo, Healthcare quality.

Introduction

Postoperative complications are defined as any event that represents a deviation in the expected postoperative course and are associated with increased morbidity and mortality rate, hospital stay, decrease in quality of life and increase health costs [1]. Therefore, the prevalence of these complications can be used to measure the standard of care and quality of healthcare delivered to patient at a given institution. There is under-registration as well as a lack of a universally established classification system to track postoperative complications following orthopedic surgery [2]. Although diverse classification systems for orthopedic postoperative complications have been described, they are often highly complex and difficult to reproduce [3,4].

Due to the need of a standardized ranking system to classify surgical complication, the Dindo-Clavien classification (DCC) (Table 1), was originally described in General Surgery. This system contemplates a scale of 1–5 of increasing severity [5,6], and has shown good reproducibility in General Surgery [7]. It has been used in other subspecialties (Urology [8], Nephrology [9], and Gastroenterology [10]). Although it has been occasionally utilized to classify postoperative complications following hip and

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spine surgery [11,12], it has not been universally used in a
register of postoperative complications after all the
surgeries of an orthopedic unit.

The purpose of this study is to determine the short-
term postoperative complication rate of our unit, estab-
lishing the classification of Dindo-Clavien to standardize
the registration and to evaluate the risk factors associated
with major and minor complications.

Materials and methods

A retrospective review of prospective collected data
from the postoperative complication registry of 1984
consecutive patients operated in the department of
orthopedic surgery at the Hospital italiano de San Justo
(125 beds, 12 orthopedic surgeons, a nosocomial that signs
a part of the healthcare network of the Hospital Italiano de
Buenos Aires) from May 2015 to June 2016 was done.
Twenty-four patients surgically treated and transferred
from another center and patients previously operated in
the same anatomical area (revision surgery) were exclud-
ed, leaving 1960 patients for analysis.

All patients were followed up to register any clinical or
surgical complication within a 90-day postoperative
period, with assessment at 15, 30 and 90 days after surgery
(postoperative control). Data were recorded in a prospec-
tively collected registry completed by staff, fellows and
residents. In addition, two trained fellows performed a 90-
day clinical chart revision. A complication was defined as
any deviation from the normal postoperative course without the need for
pharmacologic treatment or surgical, endoscopic and radiographic interventions
to treat it; Grade II complications require pharmacological
Treatment, including blood transfusions and total parenteral
nutrition; Grade III complications require surgical,
endoscopic, or radiological interventions; Grade IV
complications are life-threatening single/multi-organ
dysfunction(s) and require ICU management; and Grade
V complications result in death of the patient (Table 1).
Complications were further classified into minor (DCC I,
II, IIIa) and major (DCC IIIb, IVa, IVb and V), according
to clinical severity.

Data were collected on patients’ age and gender. The
type of surgery were classified as: elective, if the procedure
was planned in advance and scheduled without time
conditioning; scheduled urgency conditions that must be
resolved within 48–72 h of the event to decrease clinical
deterioration (e.g., closed femoral shaft fractures); non-
scheduled urgency was defined as a condition that requires
surgery within 6–12 h (e.g., open fractures, dislocations,
and compartment syndrome); and emergency for those
scenarios in which surgical intervention must be per-
formed within the first 3 h due to life-threatening
conditions (e.g., sepsis). Length of the procedure, time
of starting (morning group: surgeries starting from 8 am to
11:59 am, afternoon group: from 12 pm to 5:59 pm, or
evening group: from 6 pm to 7:59 am) were also considered.
The American Society of Anesthesiologists (ASA) [13] and
surgeon’s experience (we considered experienced surgeons
those with more than 6 years training) was also recorded.
A full-time research fellow screened all patients who met
the selection criteria. Baseline demographics, clinical
history and complications were ascertained from electron-
ic medical records.

Ethics consideration

The study protocol (Protocol number 3220) was
approved by the ethic review board from Hospital Italiano
de Buenos Aires in concordance with Helsinki declaration.

Statistical analysis

Descriptive analysis for continuous variables is shown as
mean and standard deviation or median and inter-
quartile range, according to the observed distribution.
Categorical variables are expressed as absolute number

| Grade | Definition |
|-------|------------|
| I     | Any deviation from the normal postoperative course without the need for pharmacologic treatment or surgical, endoscopic and radiographic interventions |
| II    | Requiring pharmacologic treatment with drugs |
| III   | Blood transfusions and total parenteral nutrition are also included |
| IV    | Requiring surgical, endoscopic, or radiographic intervention |
| V     | Life-threatening complication requiring ICU/ICU management |

Table 1. Classification of surgical complications according to Dindo-Clavien.
and percentage. Comparisons between groups at baseline were performed with the chi-square test for categorical variables and the Mann-Whitney U test for continuous variables. Significance was defined as $p < 0.05$. All data analyses were performed with STATA software, version 13.

Results

From 1960 surgeries analyzed, patients median age was 51.4 years (range 5–91), 1224 (62%) were female and 736 (38%) males. Overall, 249 complications were registered (12.7%) in 234 patients within the 3-month postoperative period. There were 13 patients that had more than one complication (5.5%). The median age of the complicated group was 68 years (IQR 53–79). Sixty-three percent of complications were in female patients ($n = 147$).

Complications according to Dindo-Clavien classification (DCC)

Distribution of complications according to DCC were as follows: 23/249 (9.2%) complications were classified as type I, 159/249 (63.8%) type II, 9/249 (3.6%) type IIIa, 42/249 (16.8%) type IIIb, 7/249 (2.8%) type IVa and 9/249 (3.6%) were graded as type V, there were no patients with type IVb (Table 2). On the basis of severity, 64% ($n = 191$) were minor complications and 36% ($n = 58$) were major.

Within the 159 type II complications, the most frequent was symptomatic anemia 42.1% (67/159), followed by wound infection that required antibiotics 16.9% (27/159) urinary tract infection 10% (16/159) and deep venous thrombosis 6.2% (10/159).

Regarding complications that required an additional surgery (IIIb complications) the most common event was postoperative infection 28.6% (12/42) that required surgical debridement.

No significant differences were found in sex ($p = 0.06$), surgical start time ($p = 0.33$) and operative time ($p = 0.75$), ASA score ($p = 0.117$) or surgeon’s experience ($p = 0.44$) and the severity of complications according to DCC. Regarding to age, we observed a direct relationship between age and higher grade of major complications with a median age of 58 (RIC 48–68) in grade 1 and 85 (68–92) in grade 5. The differences were significative ($p = 0.0003$).

Surgery distribution and complication rate by orthopedic subspecialty

Table 3 shows surgeries distribution and complications based on subspecialty and DCC distribution.

Surgical length and surgical start time

In the analysis of patients with complications, median surgical length was 75 min (IQR 60–120) there was no significant differences between minor and major complications ($p = 0.9$). No differences were observed in 1–5 Dindo-Clavien grades ($p = 0.55$). Regarding to surgical start time there were no differences between major and minor complications in the morning, afternoon and evening groups.

Elective, urgent and emergent surgery

Among 249 complications, 58% ($n = 145$) occurred in elective surgeries, 40% ($n = 101$) in urgent surgeries and 2% ($n = 3$) in emergent surgeries. In elective surgeries 82% of complications were minor and 18% were classified as major, in scheduled urgencies the percentage is similar (78% minor and 22% major), on the other hand, non-scheduled urgency surgery had higher rate of major complications (48%), among the three complications observed in the emergency group, two were major (66%), the differences were significant ($p = 0.001$).

Table 4 shows comparison between type of surgery (elective, scheduled urgency, non-scheduled urgency and emergency) and DCC system. The most common complications reported in our institution were from knee and hip surgery: total knee arthroplasty ($n = 52$), followed by intertrochanteric hip fractures ($n = 25$) and medial hip fractures ($n = 24$).

Multivariate analysis was performed (Table 5), female sex resulted in increase risk for major compared with minor complications, on the other hand; electives and scheduled urgencies were associated with decreased risk of major complications.

Discussion

We observed an overall short-term complication rate of 12% in orthopedic surgery during our study period. Distribution of complications according to DCC were as follows: 23/249 (9.2%) complications were classified as type I, 159/249 (63.8%) type II, 9/249 (3.6%) type IIIa, 42/249 (16.8%) type IIIb, 7/249 (2.8%) type IVa and 9/249 (3.6%) were graded as type V, there were no patients with type IVb (Table 2). On the basis of severity, 64% ($n = 191$) were minor complications and 36% ($n = 58$) were major.

The report of postoperative complications in orthopedic surgery is an important tool to measure the standard of care of a medical institution; in addition, the prevalence of complications and the study of its causes can help the surgical team to formulate different interventions to reduce or avoid their occurrence, improving patient security and reducing healthcare costs. A systematic review of randomized controlled trials has shown that many orthopedic studies lack homogeneous and standardized reporting of complications, making the outcome comparison among different studies even more difficult [2]. This same principle applies to orthopedic surgery practice. Therefore, we decided to apply the system developed by Clavien [5] that is based on the main treatment implemented to manage a complication; since this score system has shown a reliable inter-observer reproducibility [5,7].
In general surgery, some authors adapted the DCC system to different subspecialties [8–10] with favorable results and acceptable interobserver reliability. They conclude that sub specialty adaptation provides an objective and more reproducible assessment able to be compared among institutions. In orthopedics; Sink et al. adapted the DCC to hip surgery and showed a high interobserver and intraobserver reliability when compared different clinical scenarios of hip preservation surgery [11]. Additionally implementation of DCC in spine surgery also resulted in an important tool to measure surgical outcomes [12]. However, to the best of the author’s knowledge, the DCC has not been used in a department of orthopedic surgery to systematically record global postoperative complications.

The main complication observed was symptomatic anemia that required blood transfusion followed by wound infection requiring antibiotics or surgical debridement. The most common procedures related to any complication were total knee arthroplasty (TKA), intertrochanteric hip fractures that required open reduction and internal fixation (ORIF) with endomedular device and cervical hip fractures that required total hip arthroplasty, similar results were observed by Molina et al. [14].

### Table 2. Complications registered and DCC grade.

| Complication                        | Number | %    | DCC grade |
|-------------------------------------|--------|------|-----------|
| Anemia                              | 67     | 27   | II        |
| Superficial wound infection         | 27     | 10.8 | II        |
| Urinary tract infection             | 16     | 6.4  | II        |
| Vomiting/diarrhea                   | 15     | 6    | I         |
| Deep wound infection                | 12     | 4.8  | IIIb      |
| Loss of implant reduction           | 12     | 4.8  | IIIb      |
| Deep venous thrombosis              | 10     | 4    | II        |
| Death                               | 9      | 3.6  | V         |
| Prosthesis dislocation              | 9      | 3.6  | IIIa–b    |
| Wound dehiscence                    | 8      | 3.2  | I–IIb     |
| Acute urinary retention             | 8      | 3.2  | II        |
| Pneumonia                           | 8      | 3.2  | II        |
| Wound hematoma                      | 8      | 3.2  | I–II      |
| Symptomatic electrolyte abnormality | 6      | 2.4  | I         |
| Excessive postoperative pain        | 5      | 2    | I         |
| Myocardial infarction               | 4      | 1.6  | IVa       |
| Atrial fibrillation                 | 4      | 1.6  | IVa       |
| Respiratory failure                 | 3      | 1.2  | IVa       |
| Periprosthetic fracture             | 3      | 1.2  | IIIb      |
| Postoperative paralysis             | 3      | 1.2  | IIIb      |
| Sudeck syndrome                     | 2      | 0.8  | II        |
| Others                              | 10     | 4    | I–II      |

* DCC grade: Grade I (n = 23/9.2%), grade II (n = 159/63.8%), grade IIIa (n = 9/3.6%), grade IIIb (n = 42/16.8%), grade IVa (n = 7/2.8%), grade IVb (n = 0/0%) and grade V (n = 9/3.6%).

### Table 3. Patient distribution and orthopedic complication rate according to region and DCC grades.

| Region               | I  | II | IIIa | IIIb | IVa | IVb | V  | Total surgeries | Complication (n) | % |
|----------------------|----|----|------|------|-----|-----|----|-----------------|------------------|---|
| Knee surgery         | 1  | 43 | 2    | 9    | 3   | 0   | 0  | 445            | 58               | 13 |
| Foot and ankle       | 3  | 21 | 2    | 4    | 0   | 0   | 0  | 304            | 30               | 9.8|
| Trauma               | 1  | 33 | 1    | 8    | 2   | 0   | 2  | 296            | 47               | 15.8|
| Upper extremity      | 2  | 3  | 1    | 4    | 0   | 0   | 0  | 241            | 10               | 4.1|
| Shoulder             | 7  | 7  | 0    | 2    | 0   | 0   | 0  | 171            | 16               | 9.3|
| Spine                | 6  | 16 | 1    | 5    | 0   | 0   | 2  | 163            | 30               | 18.4|
| Hip surgery          | 2  | 28 | 2    | 7    | 2   | 0   | 2  | 122            | 43               | 35.2|
| Pediatric            | 1  | 5  | 0    | 0    | 0   | 0   | 0  | 68             | 6                | 8.8|
| Oncology             | 0  | 1  | 0    | 0    | 0   | 0   | 0  | 28             | 1                | 3.5|
| Emergency room       | 0  | 2  | 0    | 3    | 0   | 0   | 3  | 122            | 8                | 6.5|
Postoperative transfusions in orthopedic surgery vary significantly among clinicians and hospitals [15] and even when there are protocols to perform a blood transfusion they are not consistently used [16]. A 2013 study of 5,820 knee and hip arthroplasty surgeries found differing transfusion rates: 4.8%–63.8% for total knee and 4.3%–86.8% for THA [17]. The decision criteria for blood transfusion is not a static value, the clinical status of the patient should be taken into account [18], however, one of the most important factors considered is the preoperative hemoglobin level [19] and was the main factor considered in our institution.

When analyzing the group of 249 patients that had a 90-day postoperative complications, we observed an association between increased age and high-grade complications (DCC IIIb, IV, V) compared to minor (DCC I, II, IIIa) with significant differences. Similar results were observed in other studies [20,21]. Molina et al [14], on the other hand, observed an increase rate of minor complications in patients more than 65 years.

Prolonged operative time is known to increase the risk of major postoperative complications [22,23]. However, duration of surgery alone could be not a major determinant of complications and other factors should be considered [24]. In our study, we found no association between operative time and higher grade of complications; those results can be explained due to the heterogeneous group of surgeries performed.

Regarding to the analysis of type of surgery, we found higher grade of major complications in non-scheduled urgency and emergency surgery compared with elective and scheduled urgencies.

This study is not free of limitations; firstly, the evaluation of a heterogeneous group of surgeries, ranging from ambulatory procedures to complex surgeries makes the comparison more difficult. The variation between different orthopedic regions can be explained by several factors such as complexity or ambulatory status. The lowest rate of complications was observed in oncologic procedures, which are mainly ambulatory soft tissue resections in contrast with knee or trauma surgery, which had higher complication rate. In addition, a 90-day observation period is relatively short, making the registry of long-term complications such as late postoperative infection, periprosthetic fractures after 3 months or non-union not possible. Probably a further analysis of complication based on sub-specialties should be performed to analyze the usefulness of DCC. However, the proper registry using a uniform classification system allows understanding some outcomes, in addition, the effort to use a simple system of reporting complications can be helpful to analyze and compare postoperative results among different institutions.

Conclusion

The overall complication rate after orthopedic surgery of our unit was 12.7% and 2.8% were classified as major complications, which were more common in females, non-scheduled surgeries and emergency surgery when compared to minor complications. DCC system was useful for the purpose of our study, however, further adaptations based on type of surgery or subspeciality could improve the usefulness of this classification. The report of postoperative complications is an important tool to measure the standard of care.

Conflict of interest

The authors declare that they have no conflict of interest in relation with this paper.

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