Unplanned return to theater: A quality of care and risk management index?

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A B S T R A C T

Introduction: Surgical quality and risk management is a major public health issue. The consequences of unplanned return to theater are social, occupational, financial and even legal. Unscheduled revision surgery is a major adverse event, resulting from serious complications – some of which are thought to be avoidable. The present study sought to assess and analyze the incidence of unplanned return to theater in an orthopedic surgery department. The study hypothesis was that some of the complications involved could be avoided.

Patients and method: A mixed retrospective-prospective study examined a consecutive series of 10,158 patients operated on in an orthopedic and traumatologic surgery department between January 2011 and December 2013. Patients undergoing revision surgery for reasons directly related to the primary procedure were analyzed. Patients were distributed among the following subgroups: infection, implant dislocation; hemorrhagic complication, mechanical complication, problem of primary technique, stiffness, wound healing disorder. Specific indicators of dysfunction liable to have contributed to onset of the complication were applied in each subgroup, to determine the avoidable or unavoidable nature of the event.

Results: Two hundred and twenty-four patients (2.2%) underwent revision surgery for reasons directly related to the primary procedure. One hundred and eight cases (48.2%) were considered to have been avoidable: 48 infections (21.4%), 27 implant dislocations (12%), 15 hemorrhagic complications (6.7%), 66 mechanical complications (29.5%), 35 technical problems at primary surgery (15.6%), 21 cases of stiffness (9.3%), and 12 cases of delayed wound healing (5.3%). Mean time to revision surgery was 2.7 ± 2.6 months. Extending the time-window to 1 year recruited extra cases: in 31.7% of cases, onset was after the 90th postoperative day, which is the usual deadline. The rate of unplanned return to theater was higher after unscheduled (traumatic: 3.2%) than scheduled surgery (1.7%, P < 0.001).

Conclusion: Return to surgery in orthopedic and traumatologic surgery is underestimated. Annual incidence was 2.2%, and twice as high (3.2%) following traumatologic compared to scheduled surgery (1.7%). Analysis found that almost half the cases were avoidable. They represent a relevant and easily assessed indicator of treatment quality and associated risk management. A national or even international database in the form of an anonymous registry of revision surgeries would be useful.

Level of evidence: IV.

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1. Introduction

Surgery is the cause of most serious adverse events (SAEs) (48–79%) occurring in hospital [1–3]. In France, more than 6.5 million surgical procedures are performed each year. Incidence is 7 SAEs per 1000 days of admission in surgery [4].

Complications and SAEs requiring unplanned return to theater are probably relevant indicators of treatment quality and risk management, and it is recommended that they should be analyzed in all
surgical specialties [5–9]. SAE monitoring could identify the most frequent and most severe complications, with a view to improving the quality of care [10].

In orthopedic surgery, the main articles on the topic mostly focused on early readmission (within 30–90 days) after joint replacement [11–13], based on registry data or specific cohort studies. A recent study identified reasons for readmission within 30 days after all procedures performed in a single orthopedic department [14]. To the best of our knowledge, there have been no studies of return to theater more than 30 to 90 days after primary surgery.

The present study sought to determine the rate of reoperation on the same surgical site within the year following an orthopedic surgery procedure in a single hospital and to identify causes and risk factors. The hypothesis was that certain SAEs are avoidable.

2. Patients and method

Patient selection and classification criteria were based on published studies [1,14,15]. All patients operated on between January 1st, 2011 and December 31st, 2013 and reoperated on in the orthopedic surgery department of our center were identified, retrospectively up to December 31st, 2012 and prospectively thereafter, on the in-house database of the hospital’s Medical Information Department. All patients with at least two diagnosis-related group (DRG) roots beginning 08C, 08M or 09C within a 12-month period were included.

The database allowed admission and readmission dates, primary surgery data, readmission diagnosis and certain demographic data (age and gender) to be systematically collated. Additional data were collected from computerized medical reports and, in some cases, by individual analysis of paper records. Both day-care and conventional admissions were included.

The generally agreed interval to reoperation in the literature is 30–90 days, but concerns only early return to theater. Analysis extending to 1 year could identify late return. Patients reoperated on at the same surgical site were selected for final analysis; those with secondary treatment of a different pathology were excluded: e.g., contralateral hip or knee replacement, rotator cuff repair followed by carpal tunnel surgery, etc.

Return to theater was considered planned if scheduled ahead of the primary procedure (e.g., ligamentoplasty after osteotomy, removal of material included in the preoperative planning, etc.) and excluded from analysis; only cases of unplanned return to theater (UR) were selected.

URs were analyzed following Audige et al. [16] to determine the event cascade behind SAE onset:

- clinical presentation of SAE;
- factors potentially implicated;
- treatment;
- result and consequences for patient.

The main expected causes were classified in the usual subgroups for this kind of study [14,16]: implant dislocation, surgical site infection, hemorrhagic complication (hematoma, bleeding), delayed healing, stiffness, mechanical complication (early disassembly, secondary displacement of a well-osteosynthesized fracture, etc.), or technical problem in primary surgery liable to have contributed to UR (disassembly of substandard osteosynthesis, material immediately requiring rapid ablation, etc.) [14,16]. SAEs were considered avoidable in case of technical primary problem or non-compliance with the department’s protocols (perioperative antibiotic prophylaxis, perioperative anticoagulation treatment, check-list, etc.), and without detectable risk factors in the other cases. Classification was performed by 2 observers: an orthopedic surgeon and the head of infectious risk prevention department.

Each cause of UR was analyzed from records in search of risk factors. For infection, antibiotic prophylaxis (type, and interval before incision), skin preparation and personal history were examined, and, for hemorrhagic complications, type of anticoagulation, time to Redon drain ablation, and estimated postoperative blood loss; likewise for other causes: implant positioning in case of instability, primary fixation quality in case of secondary displacement, etc.

Multiple revision was counted as a single case, but with each procedure analyzed as above.

In scheduled surgery, total hip and knee replacement and arthroscopy were distinguished, and other procedures (hand, foot, ankle, shoulder, etc.) were grouped together as “other surgery”.

In non-scheduled surgery (mainly traumatologic emergency), femoral neck fracture (osteosynthesis or implant), wrist-elbow-forearm fracture and foreleg-ankle fracture were distinguished for subgroup analysis, and other procedures (hand, wound, shoulder, foot, knee femur, etc.) were grouped together as “other surgery”. Fig. 1 presents the methodology.

3. Statistical analysis

Results were analyzed on StatView® software, v 5.0 (SAS Institute Inc):

- for comparison of quantitative and qualitative variables, Student–Fisher matched and unmatched t-tests;
- for comparison of quantitative variables, Pearson correlation coefficient and Chi² test, with Yates correction for small subsamples.

The significance threshold was set at P < 0.05.

4. Results

Ten thousand one hundred and fifty-eight orthopedic surgery procedures were performed in the study period; 224 (2.2%) required UR within 12 months.

Comparative data per year are shown in Table 1. There were none of the “never events” (which “must never happen”) on the National Quality Forum list: side error, surgical error, instrument left behind, etc.

UR rates were higher following unscheduled surgery (3.2%) than scheduled surgery (1.7%; P < 0.001).

UR rates were stable over time, with no significant differences for any type of procedure over the 3 years studied (P = 0.43). The prospective data for 2013 did not differ from the retrospective data.

4.1. Causes of return to theater

In decreasing order of frequency, UR was motivated by mechanical complications (66 cases, 29.5%), surgery site infection (48 cases, 21.4%), primary technical problems (35 cases, 15.6%), implant dislocation (27 cases, 12%), stiffness (21 cases, 9.3%), hemorrhagic complications (15 cases, 6.7%), and wound healing defect (12 cases, 5.3%). There was no difference in distribution of causes over the 3 years (Fig. 2).

4.2. Scheduled surgery

Causes of UR comprised mechanical complications (29 cases, 24.6%), surgery site infection (20 cases, 16.9%), primary technical problems (15 cases, 12.7%), implant dislocation (15 cases, 12.7%), stiffness (16 cases, 13.6%), hemorrhagic complications (14 cases, 11.9%), and wound healing defect (9 cases, 7.6%).

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4.3. Traumatology

Causes of UR comprised mechanical complications (37 cases, 34.9%), surgery site infection (28 cases, 26.4%), primary technical problems (20 cases, 18.9%), implant dislocation (12 cases, 11.3%), stiffness (5 cases, 4.7%), hemorrhagic complications (1 case, 1%), and skin healing defect (3 cases, 2.8%).

There were significantly more surgery site infections and mechanical complications in unscheduled surgery ($P < 0.02$).

In all, 108 cases (48.2%) were considered avoidable, 22 (9.8%) doubtful, and 94 (43%) with no identifiable risk factor.

4.4. Number of revision procedures

Patients undergoing revision underwent a mean $1.24 \pm 0.6$ revision procedures (range, 1–5).

Mean interval between primary surgery and UR was $2.7 \pm 2.6$ months (range, 0–11.9 months).

Ninety-six patients (42.9%) returned to theater within 30 days, 57 patients (25.4%) during months 2 and 3, and 71 patients (31.7%) after month 3 (Fig. 3).

5. Discussion

Return to theater in orthopedic surgery is an easily measurable barometer for care quality analysis and a true index for care-related risk management. Analyses have been performed in other surgical specialties, notably outside France [2,17,18]. In Australia, Canada and the US, this index has been in regular use for 20 years.

Most studies focus on return to theater within 30–90 days of primary surgery (specific procedures). Rates range from 3.8% to 8%, according to type of procedure: 3.8% in spine surgery [13], 8% in...
Table 1
Relation between procedures and unplanned return to theater rates.

<table>
<thead>
<tr>
<th>Scheduled surgery</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total 2011/2012/2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>2244</td>
<td>2304</td>
<td>2307</td>
<td>6855</td>
</tr>
<tr>
<td>UR, n (rate %)</td>
<td>47 (2.1%)</td>
<td>41 (1.8%)</td>
<td>40 (1.7%)</td>
<td>118 (1.7%)</td>
</tr>
<tr>
<td>THR</td>
<td>291</td>
<td>311</td>
<td>363</td>
<td>965</td>
</tr>
<tr>
<td>UR THR, n (rate %)</td>
<td>11 (3.8%)</td>
<td>6 (1.9%)</td>
<td>11 (3%)</td>
<td>28 (2.9%)</td>
</tr>
<tr>
<td>TKR</td>
<td>228</td>
<td>233</td>
<td>248</td>
<td>699</td>
</tr>
<tr>
<td>UR TKR, n (rate %)</td>
<td>10 (4.3%)</td>
<td>8 (3.6%)</td>
<td>12 (4.8%)</td>
<td>30 (4.3%)</td>
</tr>
<tr>
<td>Arthroscopy</td>
<td>639</td>
<td>661</td>
<td>661</td>
<td>1921</td>
</tr>
<tr>
<td>UR arthroscopy, n (rate %)</td>
<td>6 (1%)</td>
<td>6 (1%)</td>
<td>10 (1.5%)</td>
<td>22 (1.1%)</td>
</tr>
<tr>
<td>Other</td>
<td>1184</td>
<td>1184</td>
<td>1184</td>
<td>3552</td>
</tr>
<tr>
<td>UR other, n (rate %)</td>
<td>20 (1.8%)</td>
<td>11 (0.9%)</td>
<td>7 (0.6%)</td>
<td>38 (1.2%)</td>
</tr>
<tr>
<td>Total</td>
<td>1117</td>
<td>1093</td>
<td>1093</td>
<td>3303</td>
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</table>

<table>
<thead>
<tr>
<th>Unscheduled surgery (traumatology)</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Total 2011/2012/2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>UR, n (rate %)</td>
<td>39 (1.5%)</td>
<td>28 (2.6%)</td>
<td>39 (3.6%)</td>
<td>106 (3.2%)</td>
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<tr>
<td>Femoral neck fracture</td>
<td>243</td>
<td>245</td>
<td>256</td>
<td>744</td>
</tr>
<tr>
<td>UR femoral neck fracture, n (rate %)</td>
<td>11 (4.5%)</td>
<td>13 (5.3%)</td>
<td>15 (5.9%)</td>
<td>39 (5.2%)</td>
</tr>
<tr>
<td>Wrist/forearm/elbow fracture</td>
<td>166</td>
<td>161</td>
<td>159</td>
<td>486</td>
</tr>
<tr>
<td>UR wrist/forearm/elbow fracture, n (rate %)</td>
<td>10 (6%)</td>
<td>4 (2.5%)</td>
<td>5 (5%)</td>
<td>22 (4.5%)</td>
</tr>
<tr>
<td>Foreleg/ankle fracture</td>
<td>141</td>
<td>152</td>
<td>141</td>
<td>434</td>
</tr>
<tr>
<td>UR foreleg/ankle fracture, n (rate %)</td>
<td>10 (7.1%)</td>
<td>8 (5.3%)</td>
<td>12 (8.5%)</td>
<td>30 (6.9%)</td>
</tr>
<tr>
<td>Other</td>
<td>567</td>
<td>558</td>
<td>556</td>
<td>1681</td>
</tr>
<tr>
<td>UR other, n (rate %)</td>
<td>8 (1.4%)</td>
<td>3 (0.5%)</td>
<td>4 (0.7%)</td>
<td>13 (0.9%)</td>
</tr>
<tr>
<td>Total</td>
<td>3361</td>
<td>3397</td>
<td>3400</td>
<td>10,158</td>
</tr>
<tr>
<td>UR, n (rate %)</td>
<td>86 (2.5%)</td>
<td>59 (1.7%)</td>
<td>79 (2.3%)</td>
<td>224 (2.2%)</td>
</tr>
</tbody>
</table>

UR: unplanned return to theater; THR: total hip replacement; TKR: total knee replacement.

total knee replacement [17], 5% in total hip replacement [16], and 5.9% in total shoulder replacement [12]. Dailey et al. [7] reported 3.1% readmission in orthopedic surgery over a 2-year period (102 cases), including readmission to surgical or medical departments without return to theater and return to theater within 90 days. Despite the difference in selection criteria, these findings are in agreement with the present.

In the present series, 31.7% of revision surgeries were performed more than 90 days after primary admission. Malunion, late disassembly of material and late surgery site infection are not rare and can be directly attributed to the primary procedure, despite the time interval. It thus seems more exhaustive and relevant to look at revision over a 1-year period.

Risk factors are disparate and hard to classify, but confirm that protocols can be improved. For example, Bratzler et al. [19] reported that the rate of compliance with official guidelines for perioperative antibiotic prophylaxis is only 92.6%, whereas it should be 100%.

National registries report varying findings (50–80% non-exhaustive data recording, discrepancies between registry data and patient records [20]), and do not allow precise analysis of causes for return to theater as only raw rates are reported. Registry designs are being improved, to include functional scores [21,22]. The aim is to assess specific risks adjusted to patient subgroups [23], presently lacking, but still not to determine avoidability.

The financial impact of care-related SAEs is colossal. In the USA, the extra cost associated with unplanned readmission, taking all specialties together, was estimated at $17.4 m in 2004 [24]. In general surgery, Birkmeyer et al. [10] estimated the mean overall cost of revision within 30 days for surgical complications to be $82,300 per patient, compared to $17,700 without revision. Health costs could lead to reduction in or refusal of insurance cover for hospital-acquired complications, as has recently become the case in the US for certain pathologies (“never events”: infection, errors of side, surgical error, material left behind) [25]. Given the constant increase in health costs, it would therefore be advisable to identify and hopefully limit avoidable causes of readmission, at national and international level.

In France, Michel et al. [4] analyzed multicenter SAE data for 4808 patients simultaneously admitted in surgery for a 7-day period; incidence was 7%; 32.1% of these SAEs were considered avoidable. By extrapolation (55 million days of hospital stay per year), 120,000 to 190,000 MAEs per year would be avoidable in France; certain URs count among these figures.

In the present study, 48.2% of URs were considered avoidable, as the protocols in place had not been strictly adhered to: antibiotic prophylaxis, anticoagulation, etc. Perfect application might not have prevented all SAEs, but could have helped reduce incidence. Dedicated auditing and improved care organization in response to these results have been too short-term for impact of URs to be assessed; this will only become possible in the medium-term. Even so, the analysis allowed feedback to care teams, with changes to perioperative antibiotic prophylaxis, implementation of more precise protocols and changes to material directly implicated in SAEs.

The present study shows certain limitations. The first 2 years were analyzed retrospectively. The prospective analysis, compared to the retrospective analysis for 2013, showed good concordance (3 cases added by medical IT database analysis). Initial coding quality is essential, as is the database retrieval system. Coding bias may affect reported rates, although the literature considers reliability sufficient [26].

![Fig. 3. Readmission rates according to time to discharge.](image-url)
Only readmissions to our own hospital were considered, leading to possible underestimation of the UR rate. Gruneir et al. [27], in a Canadian multicenter study, reported that patients requiring readmission were readmitted to the same institution in only 73.4% of cases.

The UR rate was influenced by the case-mix (pathology severity, mean ASA score, type of surgery, etc.) in our department, and may not be typical of other public or private sector orthopedic structures.

6. Conclusion

Revision surgery in orthopedics is underestimated, and often results from problems occurring during or around the primary procedure. Analysis finds almost half of such operations to be avoidable. They are an easily identified relevant index of treatment quality and care-related risk management. Precise analysis could determine criteria to improve hospital care and personalize follow-up for patients at high theoretic risk or reoperation. A national database in the form of an anonymous registry of surgical revision is certainly conceivable, as the analysis and method described in the present study is fully in line with the French national health authority’s 2013/2017 patient safety program released in February 2013 (http://www.sante.gouv.fr/IMG/pdf/programme_national_pour_la_securite_des_patients_2013-2017-2.pdf).

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References