Root causes of extended length of stay and unplanned readmissions after orthopedic surgery and hand surgery: a retrospective observational cohort study

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Abstract

Background: While previous studies have evaluated the effect of some patient characteristics (e.g. gender, American Society of Anesthesiologists (ASA) class and comorbidity) on outcome in orthopedic and hand day surgery, more detailed information on anesthesia related factors has previously been lacking. Our goal was to investigate the perioperative factors that affect overstay, readmission and contact after day surgery in order to find certain patient profiles more prone to problemed outcomes after day surgery.

Methods: We examined orthopedic and hand day surgery at an orthopedic day surgery unit of Helsinki University Hospital. Patient data of all adult orthopedic and hand day surgery patients (n = 542) over a 3-month period (January 1 – March 31, 2015) operated on at the unit were collected retrospectively using the hospital’s surgery database. These data comprised anesthesia and patient records with a follow-up period of 30 days post-operation. Patients under the age of 16 and patients not eligible for day surgery were excluded. Patient records were searched for an outcome of overstay, readmission or contact with the emergency room or polyclinic. Pearson chi-square test, Fischer’s exact test and multivariable logistic regression were used to analyze the effect of various perioperative factors on postoperative outcome.

Results: Various patient and anesthesia related factors were examined for their significance in the outcomes of overstay, readmission or contact. Female gender (p = 0.043), total amount of fentanyl (p = 0.00), use of remifentanil (p = 0.036), other pain medication during procedure (p = 0.005) and administration of antiemetic medication (p = 0.048) emerged as statistically significant on outcome after day surgery.

Conclusions: Overstay and readmission in orthopedic and hand day surgery were clearly connected with female patients undergoing general anesthesia and needing larger amounts of intraoperative opioids. By favoring local and regional anesthesia, side effects of general anesthesia, as well as recovery time, will decrease.

Keywords: Readmission, Overstay, Revisit, Contact, Day surgery

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**Introduction**

Day surgery is an ever-growing field. As of 2016, 67% of surgical procedures in the United States were outpatient [1]. A procedure is considered suitable as day surgery when readmissions remain below 2–4% [2, 3]. A US study showed a 30-day readmission rate of 1.2% of orthopedic outpatients [4]. Overstay rates in orthopedic day surgery have been shown to be 0.1–0.8% [3, 5]. Pain and bleeding have been the most common reasons for patients returning to the hospital after day surgery in several studies [5–8].

In 2018, day surgery procedures totaled 36,897 in the Helsinki and Uusimaa Hospital District [9]. Helsinki and Uusimaa Hospital District comprises 23 hospitals with a catchment population of over 1.6 million, making it the largest hospital district in Finland. Forty percent of all day surgery in Finland is orthopedic and hand surgery (OHS) [10]. When procedurally possible, day surgery is usually performed under local or regional anesthesia in Finland. While previous studies have examined the effect of some patient characteristics (e.g. gender, American Society of Anesthesiologists (ASA) class and comorbidity) on outcome, information on anesthesia related factors has previously been lacking. Our goal was to investigate the perioperative factors that affect overstay, readmission and contact after day surgery in order to find certain patient profiles more prone to problem outcomes after day surgery.

**Methods**

**Study design**

We studied orthopedic and hand (OHS) day surgery at Helsinki University Hospital with a special focus on overstay, readmission and contact rates. We examined the effect of local anesthesia and other perioperative factors on these outcomes. Patient data of all OHS day surgery patients (n = 542) treated during a 3-month period, between January 1, 2015 and March 31, 2015, at one of the three orthopedic day surgery units of Helsinki University Hospital, namely Herttoniemi Hospital, were collected retrospectively using the hospital’s surgery database (GE Healthcare Centricity Opera OR Management Software). These data comprised pre-, intra- and post-operative data and patient records with a follow-up period of 30 days post-operation. We chose the most common procedures using the Nordic Medico-Statistical Committee (NOMESCO) procedural codes, [11] grouped similar procedures (Table 1) and then divided them into sub-groups based on type of procedure: shoulder and elbow surgery, hand surgery and lower limb surgery.

In this study, overstay occurred if the patient was not discharged the same day as their day surgery procedure. Readmission was defined as a patient returning to the hospital after discharge and requiring treatment on the ward. A phone call or an outpatient visit to the emergency room or outpatient clinic was considered contact. Phone contacts are mentioned as most of these involved the prescribing of an antibiotic or the renewal of pain medication.

Finnish national law does not require ethics committee approval for registry studies with no patient intervention involved. Permission from the Research Administration of the Hospital District was obtained for this study.

**Table 1** Table of day surgery procedures

| Orthopedic and hand surgery procedure name | No. of day surgery patients | Overall day surgery percentage in unit |
|-------------------------------------------|----------------------------|----------------------------------------|
| Decompression of median nerve, ACC51     | 167                        | 96.5                                   |
| Discussion of sheath of tendon of wrist or hand, NDM40 | 46                        | 97.9                                   |
| Decompression of ulnar nerve, ACC53      | 43                         | 97.7                                   |
| Palmar fasciotomy of hand, NDM10         | 42                         | 100                                    |
| Incomplete excision of soft tissue tumor of wrist or hand, NDR20a | 36             | 92.3                                   |
| Arthroplasty of first CMC joint, NDG60   | 34                         | 89.5                                   |
| Excision of synovial ganglion of wrist or hand, NDM20 | 25             | 100                                    |
| Fusion of DIP joint, NDG76               | 23                         | 95.8                                   |
| Open operation for osteochondritis of joint of wrist, NDF25 | 22             | 95.7                                   |
| Arthroscopic exploration of joint of wrist or hand, NDA30 | 18             | 81.8                                   |
| Radical excision of soft tissue tumor of wrist or hand, NDR30a | 17             | 89.5                                   |
| Partial fusion of wrist, NDG20           | 16                         | 94.1                                   |
| Arthroscopic partial excision of meniscus of knee, NGD05 | 16             | 88.9                                   |
| Removal of internal fixation device from wrist or hand, NDU20 | 14             | 93.3                                   |
| Removal of internal fixation device from shoulder or upper arm, NBU20 | 12             | 85.7                                   |
| Plastic repair of ligament or capsule of wrist with transplant, NDE40 | 11             | 100                                    |

*acombined to form excision of soft tissue tumor of wrist or hand group*
Participants
Participants were chosen for day surgery during the preoperative visit according to the day surgery criteria of our clinic (Table 2), which are in line with international standards [12]. Only these patients were included in this study. Orthopedic procedures on children under the age of 16 are performed at the Helsinki University Children’s Hospital, not at the orthopedic day surgery unit, and have therefore been excluded from this study.

Data on patient demographics, including age, gender and ASA class, were gathered (Table 3) and patient charts were scrutinized with attention to overstays, readmissions and contacts within 30 days of day surgery. Anesthesia charts were examined for information on premedication, intraoperative and postoperative medication, as well as pain rating, nausea and other symptoms.

The protocol of the clinic was followed in relation to anesthesia, surgical procedure, as well as treatment and prophylaxis of pain, nausea and vomiting. The form of anesthesia was chosen according to the protocol of our clinic, which favors local/regional anesthesia whenever medically possible. Day surgery procedures of distal upper and lower extremity are mainly performed under regional anesthesia while shoulder surgery is, due to the nature of the procedure, performed under general anesthesia. The form of anesthesia was discussed with the patient, and in selected cases general anesthesia was also available upon request of the patient. Patients received perioperative antibiotic prophylaxis if any implants were used (i.e. left inside the patient) and/or if the patient had any primary disease that could increase the risk for postoperative infection. The primary perioperative antibiotic of choice in our clinic was cefuroxime 1.5 g, and, in the case of hypersensitivity, the secondary choice was clindamycin 600 mg. Both were administered intravenously.

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Statistical analysis
Pearson chi-square test, Fisher’s exact test and multivariable logistic regression were used to analyze the effect of ASA class, age, gender, type of procedure, form of anesthesia, underlying medical conditions and medications, use of laryngeal mask airway versus intubation, use of various anesthesia drugs and analgesics pre-, intra- and postoperatively, pain rating on the Numeric Rating Scale (NRS) in the recovery room, body mass index (BMI), smoking status and whether the patient was hypotensive (systolic blood pressure < 100 mmHg) or hypertensive (systolic blood pressure > 140 mmHg) during the operation on the risk of any study outcome. Overstay, readmission and contacts were chosen as study outcomes. Factors significantly associated with the risk of overstay, readmission or contact were included in the multivariable model. P-values and adjusted odds ratios (OR) with 95% confidence intervals (CI) were used to express results. With the factors found significant or near significant, combination analyses were carried out to find risk profiles. For various combinations of risk factors, OR, sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were evaluated. P-values less than 0.05 were judged to be statistically significant. The data were analyzed using IBM SPSS Statistics 25.0 (IBM. Corp., Armonk, NY).

Results
During the 3-month period, 542 orthopedic and hand surgery patients underwent day surgery. The majority of selected procedures were performed as day surgery in our clinic (Table 1). Post-operative pain and nausea or vomiting were the causes for overstay overall. The causes for readmission were operation site abscess (n = 2 readmissions) and one patient each for epigastric pain and gastroscopy, intravenous line related infection, chest pain beginning after surgery and non-ST segment elevation myocardial infarction. All readmissions occurred in the upper limb surgery groups. The most common causes for contacts were operation site infection (n = 11 contacts), pain (n = 6), swelling (n = 5), problems with wound (n = 5), problems with cast (n = 4) and operation site bleeding (n = 4).

Ten percent (n = 5) of patients had an overstay or readmission after general anesthesia compared to 0.6% (n = 3) after local or regional anesthesia. Only two procedures did not involve any contacts, overstays or readmissions: radical excision of soft tissue tumor of wrist or hand (n = 17) and arthroscopic partial excision of meniscus of knee (n = 16). The overall readmission rate was 1.1%, overstay rate 0.7% and contact rate 9.0%. There were no deaths during the follow-up period.

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Table 2 Day surgery criteria

| Operation duration < 3 h |
|-------------------------|
| No significant risk of respiratory tract swelling |
| No respiratory tract anomalies |
| No or stable chronic disease |
| No obstructive sleep apnea |
| Body mass index < 35 |
| Ability to climb more than 2 flights of stairs without stopping |
| Ability to care for oneself independently |
| No unstable psychiatric illnesses |
| No drug or alcohol addiction |
| Caregiver over the age of 16 at home for first postoperative night |
Gender, fentanyl, other pain medication during procedure, remifentanil and antiemetic medication rose to statistical significance ($p < 0.05$) (Tables 4 and 5).

Oxycodone, general anesthesia, plexus block and postoperative pain medication were borderline significant ($p < 0.10$) (Tables 5 and 6).

These factors were joined in various combinations to find risk profiles for outcomes (Table 7). Other pain medication during procedure and postoperative pain medication were not included in the risk profile due to small sample size when combined with another risk factor.

For each patient, we studied the form of anesthesia used (Table 1). The majority of orthopedic and hand surgery procedures were performed under regional or local anesthesia. All overstays and half of readmissions occurred in patients after general anesthesia. All of these readmissions and half of these readmissions occurred in the group of 11 patients that underwent a partial fusion of the wrist with bone graft under general anesthesia. Eleven out of 49 contacts involved general anesthesia patients.

The standard premedication at the orthopedic and hand day surgery unit is paracetamol, etoricoxib and diazepam. Most patients received some combination of these three drugs. Premedication was adjusted according to allergies and possible medication in use. In addition to oxycodone, fentanyl and remifentanil, other pain medication administered during procedures included paracetamol, nonsteroidal anti-inflammatory drugs (NSAID) and other strong analgesics (Table 5). Postoperative pain medication included NSAIDs, paracetamol, weak opioids and strong analgesics. Pain was recorded in the recovery room on the NRS and the average of these answers for each patient was calculated (Table 6). The administration of antiemetic medication was significant ($p = 0.048$) for an outcome but the particular medication was not ($p = 0.107$).

Discussion
Female gender, total amount of intraoperative and postoperative fentanyl, intraoperative administration of remifentanil, other pain medication during procedure and administration of antiemetic medication emerged as statistically significant. General anesthesia, plexus block, total amount of intraoperative and postoperative oxycodone and postoperative pain medication were borderline significant factors on outcome after day surgery.

Risk profiles
Ten combinations of risk predictors for any outcome of overnight, readmission or contact produced significant odds ratios of over four to 15 times higher than patients with none of these risk predictors (Table 7). The highest risk was for two profiles: both profiles comprised females with a large amount of fentanyl; one administered with remifentanil, the other plexus block. Both of these profiles were capable of identifying half of patients with study outcomes. While the total amount of fentanyl cannot be predicted preoperatively, gender and the need for remifentanil and plexus block are known before surgery. Patients with these risk predictors need to be evaluated more thoroughly and postoperative contingency plans set into place. The suitability of these patients for day surgery must also be assessed.

Overstay
Nausea and vomiting comprised the most common reasons for overnight. As many as 55% of day surgery patients experience post-operative nausea and vomiting [13]. Tracheal intubation and opioid use are both contributing factors to the onset of these symptoms, with female gender shown to triple the risk [14]. In our study, both overnight due to nausea and vomiting involved male patients. Nonetheless, both cases involved the factors found significant for outcomes: a large amount of oxycodone and fentanyl, use of

**Table 3** Patient demographics in 542 day surgery procedures

|                      | Hand surgery | Shoulder & elbow surgery | Lower limb surgery |
|----------------------|--------------|---------------------------|--------------------|
| Patients (n)         | 471          | 55                        | 16                 |
| Male %               | 37.4         | 58.2                      | 56.3               |
| Age median (range)   | 53.8 (16.2–92.5) | 54.3 (23.2–72.2)         | 42.2 (21.1–63.3)   |
| ASA class median (range) | 2 (1–4)     | 2 (1–4)                   | 1 (1–3)            |
| Anesthesia           |              |                           |                    |
| Local (%)            | 42.7         | 10.9                      |                    |
| Regional (%)         | 49.7         | 65.5                      | 93.7               |
| General (%)          | 7.6          | 23.6                      | 6.3                |
remifentanil and general anesthesia. Our overstay rate was 0.7%, which is in line with a previous study in the United Kingdom showing an overstay rate of 0.79% after orthopedic day surgery [3].

Readmissions and contacts
The most contacts and readmissions occurred in the hand surgery group with the most frequent reason being operation site infection, comprising a post-operative infection rate of 1.1%. Of these patients, two received peri-operative antibiotic prophylaxis. Some patients had an underlying medical condition or factor, such as severe depression, diabetes or smoking, which could have predisposed to infection. Operation site infection in hand surgery is reported to vary from 0.36 to 3.8%, with one study reporting a rate as high as 10.7% [15–18]. Previous studies have shown US readmissions rates to be 1.2–2.5% for orthopedic day surgery [4, 6]. Our readmission rate of 1.1% is less than proposed in the guideline of the Royal College of Surgeons.

Exceptions to day surgery criteria
While no obstructive sleep apnea and BMI < 35 are both day surgery eligibility criteria, 52 patients had a BMI greater than 35 and 20 had sleep apnea. Those with sleep apnea had no study outcomes, while of those with BMI > 35, only three patients had outcomes, which were related to a large amount of opioids, diabetes or trauma.

| Table 4 | Patient related factors and their effect on postoperative outcome in OHS day surgery |
|---------|----------------------------------------------------------------------------------|
| Factor  | No. Of patients | n (%) of outcomes | P-value |
| Gender  | 542              |                      |        |
| Male    | 217              | 9 (4.1)              | 0.043  |
| Female  | 325              | 28 (8.6)             |        |
| Age (years) | 542 |                      | 0.465  |
| 16–44   | 153              | 9 (5.9)              |        |
| 45–64   | 292              | 20 (6.8)             |        |
| 65–74   | 68               | 4 (5.9)              |        |
| 75+     | 29               | 4 (13.8)             |        |
| BMI (kg/m2) | 542 |                      | 0.422  |
| < 20    | 29               | 1 (3.4)              |        |
| 20–24.9 | 183              | 8 (4.4)              |        |
| 25–29.9 | 176              | 16 (9.1)             |        |
| 30.0–34.9 | 102 | 9 (8.8)              |        |
| 35–39.9 | 32               | 1 (3.1)              |        |
| 40–44.9 | 16               | 2 (12.5)             |        |
| 45–49.9 | 3                | 0 (0)                |        |
| 50–54.9 | 1                | 0 (0)                |        |
| ASA class | 539  |                      | 0.226  |
| 1       | 176              | 9 (5.1)              |        |
| 2       | 228              | 13 (5.7)             |        |
| 3–4     | 135              | 13 (9.6)             |        |
| Cardiovascular disease | 542 |                      | 0.96   |
| yes     | 203              | 14 (6.9)             |        |
| no      | 339              | 23 (6.8)             |        |
| Anticoagulant | 541 |                      | 0.683  |
| no      | 525              | 36 (6.9)             |        |
| warfarin | 8    | 1 (12.5)             |        |
| aspirin | 6                | 0 (0)                |        |
| NOAC    | 2                | 0 (0)                |        |
| Diabetes | 542  |                      | 0.17   |
| yes     | 61               | 7 (11.5)             |        |
| no      | 481              | 30 (6.2)             |        |
| Pulmonary disease | 542 |                      | 0.413  |
| yes     | 60               | 2 (3.3)              |        |
| no      | 482              | 35 (7.3)             |        |
| Sleep apnea | 542 |                      | 0.386  |
| yes     | 20               | 0 (0)                |        |
| no      | 522              | 37 (7.1)             |        |
| Migraine/Headache | 542 |                      | 0.576  |
| yes     | 12               | 1 (8.3)              |        |
| no      | 530              | 36 (6.8)             |        |
| Psychiatric condition | 542 |                      | 0.512  |
| yes     | 41               | 4 (9.8)              |        |

Table 4. Patient related factors and their effect on postoperative outcome in OHS day surgery (Continued)

| Factor                        | No. Of patients | n (%) of outcomes | P-value |
|-------------------------------|-----------------|-------------------|--------|
| no                            | 501             | 33 (6.6)          |        |
| Meniere/vertigo               | 542             |                   |        |
| yes                           | 3               | 0 (0)             |        |
| no                            | 539             | 37 (6.9)          |        |
| Immunosuppression             | 542             |                   |        |
| yes                           | 20              | 2 (10.0)          |        |
| no                            | 522             | 35 (6.7)          |        |
| Other underlying medical     | 542             |                   | 0.837  |
| condition                     | yes             | 118              | 7 (5.9) |
| no                            | 424             | 30 (7.1)          |        |
| Smoking status                | 534             |                   | 0.549  |
| yes                           | 378             | 22 (5.8)          |        |
| no                            | 140             | 12 (8.6)          |        |
| quit                          | 12              | 1 (8.3)           |        |
| sometimes                     | 4               | 0 (0)             |        |

BMI Body mass index, ASA American Society of Anesthesiologists, NOAC Novel oral anticoagulant.
to operation site from falling. However, of all 52 obese patients, all except two were operated on under regional or local anesthesia and only one of these two had an outcome. Based on these data, it may be prudent to re-visit the strictness of the BMI criteria.

Gender
Female gender was a risk factor for outcomes. The majority (60%) of patients in this study were female. The most common procedure (30.8%) in this study was decompression of the median nerve, which is most typically performed on middle-aged women. In our study, women undergoing this procedure numbered 74.4%. Of procedures performed on women, 6.2% underwent general anesthesia, whereas of those performed on men, 13.8% underwent general anesthesia. Five of eight patients with overstays and readmissions were female. Most outcomes involving women were, however, for more minor problems than those of men. Women, in general, are more prone to use healthcare services more frequently [19–21]. This may explain why women had more outcomes in our study.

Table 5
Anesthesia and analgesia drug related factors and their effect on outcomes in OHS day surgery

| Factor | No. Of patients | N (%) of outcomes | P-value |
|--------|-----------------|-------------------|---------|
| Premedication paracetamol | 539 | 1 | |
| yes | 510 | 35 (6.9) | |
| no | 29 | 2 (6.9) | |
| Premedication NSAID | 539 | 0.423 | |
| yes | 339 | 21 (6.2) | |
| no | 200 | 16 (8.0) | |
| Premedication diazepam | 539 | 0.391 | |
| yes | 226 | 18 (8.0) | |
| no | 313 | 19 (6.1) | |
| Oxycodone i.v. (mg) | 539 | 0.064 | |
| 0–10 | 525 | 34 (6.5) | |
| > 10 | 14 | 3 (21.4) | |
| Fentanyl i.v. (mg) | 539 | 0.00 | |
| 0–0.15 | 502 | 29 (5.8) | |
| > 0.15 | 37 | 8 (21.6) | |
| Other pain medication during procedure | 539 | 0.005 | |
| no | 527 | 33 (6.3) | |
| NSAID (ketoprofen) | 1 | 0 (0) | |
| paracetamol | 3 | 2 (6.7) | |
| other strong analgesic (alfentanil, esketamine) | 8 | 2 (25.0) | |
| Remifentanil | 542 | 0.036 | |
| yes | 48 | 7 (14.6) | |
| no | 494 | 30 (6.1) | |
| Propofol | 542 | 0.117 | |
| no | 476 | 29 (6.1) | |
| general anesthesia | 55 | 7 (12.7) | |
| sedation | 11 | 1 (9.1) | |
| Sevoflurane | 542 | 1 | |
| yes | 1 | 0 (0) | |
| no | 541 | 37 (6.8) | |
| Glycopyrrolate | 542 | 0.656 | |
| yes | 22 | 2 (9.1) | |
| no | 520 | 35 (6.7) | |
| Dexamethasone | 542 | 0.111 | |
| yes | 45 | 6 (13.3) | |
| no | 497 | 31 (6.2) | |
| Rocuronium | 541 | 0.247 | |
| yes | 4 | 1 (25.0) | |
| no | 537 | 36 (6.7) | |
| Antiemetic medication | 540 | 0.107 | |
| no | 519 | 33 (6.4) | |

Table 5 Anesthesia and analgesia drug related factors and their effect on outcomes in OHS day surgery (Continued)

| Factor | No. Of patients | N (%) of outcomes | P-value |
|--------|-----------------|-------------------|---------|
| Ondansetron 4 mg | 20 | 4 (20.0) | |
| Metoclopramide 10 mg | 1 | 0 (0) | |
| Antiemetic medication | 540 | 0.048 | |
| yes | 21 | 4 (19.0) | |
| no | 519 | 33 (6.4) | |
| Postoperative pain medication | 539 | 0.08 | |
| no | 520 | 34 (6.5) | |
| NSAID (ibuprofen, ketoprofen) | 8 | 0 (0) | |
| paracetamol | 9 | 3 (33.3) | |
| weak opioids (paracetamol-codeine) | 1 | 0 (0) | |
| strong analgesics (esketamine) | 1 | 0 (0) | |

NSAID Nonsteroidal anti-inflammatory drug, i.v. intravenous

Problematic procedures
Recuperation from two procedures, removal of internal fixation device from shoulder (NBU20) and partial fusion of wrist (NDG20), is significantly more painful than for other procedures included in this study and these patients require a greater amount of pain management at the day surgery unit and at home. The majority of these procedures were performed under general anesthesia
due to their nature. Most of the overstays and readmissions in this study were from these two procedures. Of the six NDG20 patients with outcomes, five were operated on under general anesthesia and one with only a plexus block. During general anesthesia, remifentanil infusion and repeated doses of fentanyl are given typically during operations known to be painful, such as shoulder surgery or fusion of the wrist. Some may argue that these procedures are known to be painful and therefore not appropriate for day surgery. However, as long as this risk is acknowledged and the patient is informed that recuperation may be rocky, these procedures are possible to be carried out as day surgery.

Limitations of the study
Our study has some limitations. The anesthesia charts of three patients were not found in their files but the majority of information necessary for the study was obtained from electronic patient charts. Only intraoperative information remained lacking. The majority of OHS patients belonged to the hand surgery group, thus skewing the sizes of the groups and interpretation of the data. This study was performed retrospectively. Therefore, we lack knowledge pertaining to possible visits to hospitals outside of our hospital district, to the patient’s own general practitioner or private healthcare producer. These visits are presumably infrequent as patients are directed to contact the hospital where the procedure was performed in case of post-operative issues. Primary care centers are also usually ill equipped to treat emergency issues, such as post-operative hemorrhage. Retrospective data may also lack some information due to charting errors or absent-mindedness. No patients were contacted in regard to their recuperation.

With general anesthesia as a borderline significant risk for outcomes, more and more procedures should be performed under local or regional anesthesia. However, this can only be achieved when medically and procedurally prudent. Due to the nature of shoulder surgery, general anesthesia with or without a plexus block is most often the anesthesia method of choice, despite the risk of increased outcomes. While females had more outcomes than males, this may be due to women using healthcare services more in general. Nevertheless, pre- and post-operative patient guidance is essential. Patients must be selected meticulously and their concerns, in regard to day surgery and form of anesthesia, listened to carefully.

Conclusion
International day surgery selection criteria have been fine-tuned over the years. Our hospital follows these criteria and our low overstay and readmission rates validate them once again. Overstay and readmission were clearly connected with those OHS patients undergoing general

| Table 6 Miscellaneous operation related factors and their effect on outcomes in OHS day surgery |
|---------------------------------------------------------------|
| Factor                        | No. Of patients | n (%) of outcomes | P-value |
|--------------------------------|-----------------|--------------------|---------|
| Procedure group               | 542             | 0.835              |         |
| Hand surgery                  | 471             | 33 (7.0)           |         |
| Shoulder & elbow surgery      | 55              | 4 (7.3)            |         |
| Lower limb surgery            | 16              | 0 (0)              |         |
| Laryngeal mask airway or intubation | 542      | 0.137              |         |
| neither                       | 488             | 30 (6.1)           |         |
| laryngeal mask airway         | 51              | 7 (13.7)           |         |
| intubation                    | 3               | 0 (0)              |         |
| General anesthesia            | 542             | 0.077              |         |
| yes                           | 53              | 7 (13.2)           |         |
| no                            | 489             | 30 (6.1)           |         |
| Plexus block                  | 541             | 0.086              |         |
| yes                           | 166             | 16 (9.6)           |         |
| no                            | 375             | 21 (5.6)           |         |
| Intravenous regional anesthesia | 542         | 0.456              |         |
| yes                           | 114             | 6 (5.3)            |         |
| no                            | 428             | 31 (7.2)           |         |
| Spinal anesthesia             | 542             | 0.617              |         |
| yes                           | 16              | 0 (0)              |         |
| no                            | 526             | 37 (7.0)           |         |
| Infiltrative anesthesia       | 542             | 0.544              |         |
| yes                           | 326             | 24 (7.4)           |         |
| no                            | 216             | 13 (6.0)           |         |
| Peripheral nerve block        | 542             | 1                  |         |
| yes                           | 18              | 1 (5.6)            |         |
| no                            | 524             | 36 (6.9)           |         |
| NRS recovery room             | 539             | 0.384              |         |
| no pain                       | 467             | 31 (6.6)           |         |
| mild 1–3                      | 41              | 3 (7.3)            |         |
| moderate 4–6                  | 27              | 2 (7.4)            |         |
| severe 7–10                   | 4               | 1 (25.0)           |         |
| Hypotensive during procedure  | 540             | 0.794              |         |
| yes                           | 66              | 5 (7.6)            |         |
| no                            | 474             | 32 (6.8)           |         |
| Hypertensive during procedure | 540             | 0.959              |         |
| yes                           | 396             | 27 (6.8)           |         |
| no                            | 144             | 10 (6.9)           |         |

NRS Numerical rating system
anesthesia and needing larger amounts of intraoperative opioids. Nevertheless, due to the nature of some procedures and individual patient characteristics, general anesthesia cannot be completely phased out. Of course, it is impossible to prevent all post-operative complications and contacts but through meticulous patient instruction and selection, we can facilitate prompt emergent care. By favoring local and regional anesthesia, or when medically possible combining regional anesthesia with general anesthesia and thus decreasing the need of intraoperative opioids, side effects of general anesthesia, as well as recovery time, will decrease.

Abbreviations
ASA: American Society of Anesthesiologists; BMI: Body mass index; CI: Confidence interval; i.v.: Intravenous; NOAC: Novel oral anticoagulant; NOMESCO: Nordic Medico-Statistical Committee; NPV: Negative predictive value; NRS: Numerical rating system; NSAID: Nonsteroidal anti-inflammatory drug; OHS: Orthopedic and hand surgery; OR: Odds ratio; PPV: Positive predictive value

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Competing interests
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Table 7 Various risk profiles for outcomes in OHS day surgery

| Combination | Total N | n of patients | OR (95% CI) | P-value | PPV   | NPV   | Specificity | Sensitivity |
|-------------|---------|---------------|-------------|---------|-------|-------|-------------|-------------|
| Female & Fentanyl ≥0.16 mg i.v. | 539 | 16 | 6.97 (2.29–21.29) | < 0.001 | 31.3% | 93.9% | 97.8% | 13.5% |
| Female & Remifentanil | 542 | 18 | 4.25 (1.33–13.64) | 0.015 | 22.2% | 93.7% | 97.2% | 10.8% |
| Fentanyl ≥0.16 mg i.v. & Remifentanil | 539 | 26 | 5.93 (2.31–15.21) | < 0.001 | 26.9% | 94.2% | 96.2% | 18.9% |
| Female & Fentanyl ≥0.16 mg i.v. & Remifentanil | 539 | 8 | 15.09 (3.61–63.06) | < 0.001 | 50.0% | 93.8% | 99.2% | 10.8% |
| Fentanyl ≥0.16 mg i.v. & General anesthesia | 539 | 30 | 4.86 (1.93–12.23) | < 0.001 | 23.3% | 94.1% | 95.4% | 18.9% |
| Fentanyl ≥0.16 mg i.v. & Plexus block | 538 | 18 | 5.87 (1.97–17.47) | 0.001 | 27.8% | 93.8% | 97.4% | 13.5% |
| Fentanyl ≥0.16 mg i.v. & Remifentanil & General anesthesia | 539 | 26 | 5.93 (2.31–15.21) | < 0.001 | 26.9% | 94.2% | 96.2% | 18.9% |
| Female & Fentanyl ≥0.16 mg i.v. & General anesthesia | 539 | 10 | 10.02 (2.70–37.26) | < 0.001 | 40.0% | 93.8% | 98.8% | 10.8% |
| Female & Fentanyl ≥0.16 mg i.v. & Plexus block | 538 | 6 | 14.65 (2.85–75.33) | 0.001 | 50.0% | 93.6% | 99.4% | 8.1% |
| Female & Antiemetic medication | 540 | 13 | 6.65 (1.95–22.75) | 0.003 | 30.8% | 93.7% | 98.2% | 10.8% |
| Fentanyl ≥0.16 & Antiemetic medication | 539 | 14 | 2.33 (0.50–10.84) | 0.280 | 14.3% | 93.3% | 97.6% | 5.4% |

OR Odds ratio, CI Confidence interval, PPV Positive predictive value, NPV Negative predictive value, i.v. Intravenous
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