Arthroplasty Today 26 (2024) 101343

Contents lists available at ScienceDirect

Arthroplasty Today

journal homepage: http://www.arthroplastytoday.org/

Original Research

Perioperative Differences Between Outpatient and Inpatient Pathways Following Hip and Knee Arthroplasty

Mark H.F. Keulen, MD[a, b, *], Yoeri F.L. Bemelmans, MSc, PhD[b], B. Boonen, MD, PhD[b], Roel P.M. Hendrickx, MD[b], Ide C. Heyligers, MD, PhD[a], Martijn G.M. Schotanus, MSc, PhD[b, c]

[a] Faculty of Health, Medicine and Life Sciences, School of Health Professions Education (SHE), Maastricht University, Maastricht, The Netherlands
[b] Department of Orthopaedic Surgery and Traumatology, Zuyderland Medical Center Heerlen and Sittard-Geleen, Geleen, The Netherlands
[c] Faculty of Health, Medicine & Life Sciences, School of Care and Public Health Research Institute, Maastricht University Medical Centre, Maastricht, The Netherlands

ARTICLE INFO

Article history:
Received 19 July 2023
Received in revised form
4 November 2023
Accepted 3 February 2024
Available online xxx

Keywords:
Clinical pathway
Outpatient
Outpatient arthroplasty
Perioperative care
Total hip arthroplasty
Total knee arthroplasty

ABSTRACT

Background: Optimization of clinical pathways and logistics led to the introduction of outpatient joint arthroplasty of the hip and knee. Nevertheless, little is known about what these current protocols look like and how they differ from "standard" inpatient protocols. This study aimed to find preoperative, intraoperative, and postoperative differences between outpatient and inpatient pathways.
Methods: A questionnaire (ranging between 23 and 37 items) was developed and administered by email to orthopedic surgeons who were a member of the Dutch Hip Society and Dutch Knee Society. Survey response rate was 38% (N = 117).
Results: No significant differences were found in preoperative pathway characteristics. The administration regime for tranexamic acid significantly differed between outpatient and inpatient pathways ($P < .001$ and $P = .002$ for hip and knee arthroplasty, respectively), with outpatient pathways using a combined (eg, oral and intravenous) administration regime more frequently. The perioperative antibiotic prophylaxis regime also significantly differed between outpatient and inpatient pathways ($P < .001$ and $P = .014$, respectively), with outpatient pathways more frequently incorporating fewer antibiotic doses. Same-day postoperative mobilization significantly less often occurred if surgery took place later that day in inpatient hip arthroplasty pathways (24%; $P = .034$). Postoperative hemoglobin-check occurred significantly more often on indication in outpatient than in inpatient hip and knee arthroplasty pathways (~75% vs ~25%; $P = .001$).
Conclusions: Few intraoperative and postoperative differences in outpatient and inpatient pathways were found and probably mainly relied on logistical grounds. Nonetheless, findings suggested that outpatient pathways tended to be more up-to-date and innovative than inpatient pathways.

Introduction

Clinical pathways were introduced in the United States in the 1980s to cut the costs and to reduce variation in care that does not influence outcome. It is basically an algorithm that outlines a structured evidence-based sequence and timing of interventions for the care of a specific group of patients with a particular diagnosis or procedure. The purpose is to standardize procedures to ensure an optimal and reproducible outcome regarding quality, efficiency, and economic saving. Nowadays these pathways are widely implemented in high-volume, high-cost, and high-predictable care processes [1].

A variant on a clinical pathway was developed by Kehlet in an effort to improve recovery after colorectal surgery: enhanced recovery after surgery (ERAS) [2]. He hypothesized that the surgical stress response was the key pathogenic factor in postoperative morbidity and contributed to “organ dysfunction” by metabolic and

* Corresponding author. Faculty of Health, Medicine and Life Sciences, School of Health Professions Education (SHE), Maastricht University, Universiteitssingel 60, 6229 ER Maastricht, The Netherlands. Tel: +31 6 5104 9453.
E-mail address: markkeulen@hotmail.com

https://doi.org/10.1016/j.artd.2024.101343

endocrine derangements (eg, pain, postoperative nausea and vomiting, fatigue). As no single surgical/anesthetic technique or drug regimen had been shown to eliminate postoperative morbidity, the ERAS concept promoted a multimodal approach to address the surgical stress response with multidisciplinary team effort [3]. In the last 2 decades, these "fast-track" pathways have also been implemented in hip and knee arthroplasty and successfully proved to enhance recovery and patient satisfaction with care, decrease morbidity, and effectively reduce hospital length of stay (LOS) and healthcare costs [4,5].

Auditing is another important feature of the "fast-track" concept, constantly revisiting and evaluating routines and current practices in an attempt to incorporate new evidence-based clinical features in the perioperative pathway to promote recovery. As a result of these continuous improvements in perioperative care—in combination with optimized pathway and hospital logistics—outpatient joint arthroplasty (OJA; discharging patients on the same day of surgery) pathways emerged in several clinics [6,7]. These OJA pathways have been proven to be feasible and safe in a selected group of patients, and so they are gaining popularity [8-10].

Although evidence and consensus statements exist for the organization of perioperative care in total joint arthroplasty (TJA) of the hip and knee, there are no studies comparing perioperative features of outpatient vs standard inpatient pathways. The primary research purpose of this study was to assess preoperative, intraoperative, and postoperative differences between outpatient and standard inpatient pathways following hip and knee arthroplasty in The Netherlands. We hypothesized that outpatient pathways contained more state-of-the-art features of perioperative care when compared to inpatient pathways.

Material and methods

This study was approved by the local institutional review board (study number Z20210053).

Setting and subjects

This study was conducted as a follow-up survey among the same study population (active members of the Dutch Hip Society and the Dutch Knee Society) as described previously by our research team [11].

Questionnaire

A new questionnaire was developed and concerns a follow-up to a previous questionnaire (on the surgeon's perspective on the implementation of OJA), the results of which have already been published [11]. The questionnaire comprised 4 sections to determine surgeon's baseline characteristics and to identify preoperative, intraoperative, and postoperative features of current outpatient or inpatient pathways. If the respondent performed OJA, then all subsequent questions were intended to specify their outpatient pathway (and vice versa). Outpatient was defined as patients who were discharged to their own home environment on the day of surgery and who do not have an overnight stay at either the hospital or another non-home facility [9,11,12].

The number of questionnaire items varied individually between 23 and 37 based on the responses of the participants. An English version of the questionnaire is presented in Appendix A.

Statistics

All analyses were performed with SPSS (IBM Corp. Released 2019. IBM SPSS Statistics for Windows, Version 26.0; IBM Corp., Armonk, NY).

Descriptives were displayed as means with standard deviations (and range) for continuous variables and frequencies with percentages for categorical variables.

Differences between outpatient and inpatient pathways were assessed using chi-square or (in case of cells with an expected value < 5) Fisher's exact test for categorical variables and an unpaired *t*-test for continuous variables. A two-sided *P*-value $\leq .05$ was considered to indicate statistical significance.

Study population

Our prior administered survey was completed by 123 of 331 orthopedic surgeons [11]. One hundred seventeen of 123 respondents (95%) completed the follow-up survey and were included in the analysis. This resulted in a response rate of 35.3% for the entire study population. Demographics of respondents are summarized in Table 1.

Results

Preoperative pathway characteristics

Informative leaflets were the most frequently used type of education tool. Prehabilitation was used by ~35% of respondents in both hip and knee arthroplasty procedures. No major differences were found between outpatient and inpatient pathways (Tables 2 and 3).

Approximately 80% of respondents made use of preoperative screening tools. The most used screening tool was the American Society of Anesthesiologists (ASA) classification. Protocollary defined selection criteria were more frequently used in outpatient (~45%) compared with inpatient hip and knee arthroplasty (14% and 24%, respectively) pathways (Tables 2 and 3).

Intraoperative pathway characteristics

Anesthesia

Spinal anesthesia (with or without sedation) was the most frequently used type of anesthesia (~75%). Little use of peripheral nerve (eg, femoral/saphenous) blocks (PNBs) was reported and was only limited to inpatient pathways (6% in hip arthroplasty and 24% in knee arthroplasty). The use of local infiltration anesthesia (LIA) was common in knee arthroplasty (96%), but not in hip arthroplasty pathways (7.2%). No differences were found between outpatient and inpatient pathways (Tables 4 and 5).

Surgical techniques

The posterolateral (PL) approach was preferred by most respondents (58%) in total hip arthroplasty (THA). Higher rates of the direct anterior approach (DAA) were observed in outpatient than in inpatient hip arthroplasty pathways (53% vs 29%, $P = .057$). Most respondents (98%) preferred the medial parapatellar (MMP) approach in total knee arthroplasty (TKA; Tables 4 and 5).

Intraoperative medication

Tranexamic acid (TXA) was used by all respondents. Great variability—in when (perioperative timing) and how (route) TXA was administered—was observed in both hip and knee arthroplasty pathways (Tables 4 and 5). Significant differences between outpatient and inpatient pathways on route of administration were found in both hip and knee arthroplasty ($P < .001$ and $P = .002$, respectively).

Table 1
Demographics of the respondents.

Characteristic	Total	OJA	Non-OJA	*P* value
Number of respondents (N)	117	20	97	
Age (y)	46 ± 8.9 (32-66)	47 ± 9.3 (32-66)	46 ± 8.8 (33-63)	.74
Sex				1.0
Female	3 (2.6%)	0 (0%)	3 (3.1%)	
Male	114 (97%)	20 (100%)	94 (97%)	
Affiliation				.13
Academic (university) hospital	13 (11%)	0 (0%)	13 (13%)	
Non-academic teaching hospital	54 (46%)	14 (70%)	40 (41%)	
Non-academic non-teaching hospital	33 (28%)	4 (20%)	29 (30%)	
Private clinic	13 (11%)	2 (10%)	11 (11%)	
Other	4 (3.4%)	0 (0%)	4 (4.1%)	
Orthopedic (sub) specialty				.25
Hip and knee arthroplasty	68 (58%)	13 (65%)	55 (57%)	
Only hip arthroplasty	15 (13%)	4 (20%)	11 (11%)	
Only knee arthroplasty	34 (29%)	3 (15%)	31 (32%)	
Hip arthroplasty group[a]				
N, surgeons	83	17	66	
N, surgeries (per year)	116 ± 62 (20-330)	150 ± 71 (70-330)	108 ± 57 (20-280)	**.011**
Types of hip arthroplasty				
Primary	83 (100%)	17 (100%)	66 (100%)	N/a
Revision	60 (72%)	13 (76%)	47 (71%)	.77
Knee arthroplasty group[a]				
N, surgeons	102	16	86	.42
N, surgeries (per year)	102 ± 66 (10-380)	114 ± 46 (40-180)	100 ± 69 (10-380)	
Types of knee arthroplasty				
Primary	102 (100%)	16 (100%)	86 (100%)	N/a
Revision	64 (63%)	10 (63%)	54 (63%)	.98

OJA, outpatient joint arthroplasty.
Discrete variables are given as frequency (percentage), and continuous variables as mean ± standard deviation (range); bold values indicate statistically significant difference ($P < .05$).
[a] Respondents that perform "hip AND knee arthroplasty" are included in both the hip arthroplasty group and the knee arthroplasty group.

Also, great variability was observed in the use of antibiotic prophylaxis (Tables 4 and 5). Significant differences in the number of antibiotic doses were found between outpatient and inpatient pathways in both hip and knee arthroplasty ($P < .001$ and $P = .014$, respectively).

Postoperative pathway characteristics

The timing of postoperative mobilization significantly differed between outpatient and inpatient pathways for hip arthroplasty ($P = .034$). In 24% of inpatient pathways, mobilization was delayed to the next day if surgery took place later that day (Table 6).

Postoperative medication

The majority of respondents preferred low-molecular-weight heparins as a type of anticoagulant (~80%) and with a 4- to 6-week length of anticoagulant use (~93%). The preferred length of anticoagulant prophylaxis significantly differed between outpatient and inpatient pathways for knee arthroplasty ($P = .043$), but not for hip arthroplasty ($P = .12$) (Tables 6 and 7).

Although outpatient pathways more frequently incorporated opioid-sparing regimes in postoperative pain management, no statistically significant differences were observed between pathways (~70% vs 55%, $P \geq .40$) (Tables 6 and 7).

Table 2
Preoperative characteristics of the outpatient and inpatient hip arthroplasty pathway.

Characteristic	Total	Outpatient	Inpatient	*P* value
Number of respondents	83	17	66	
Preoperative education	83 (100%)	17 (100%)	66 (100%)	N/a
Type of education used[a]				N/a
Verbal	61 (73%)	14 (82%)	47 (71%)	
Informative leaflets	78 (94%)	17 (100%)	61 (92%)	
Videos	35 (42%)	5 (29%)	30 (45%)	
Decision aids	33 (40%)	7 (41%)	26 (39%)	
eHealth (eg, patient journey app)	24 (29%)	4 (24%)	20 (30%)	
Other	5 (6.0%)	1 (5.9%)	4 (6.1%)	
Pre-habilitation	27 (33%)	8 (47%)	19 (29%)	.16
Preoperative screening	66 (80%)	15 (88%)	51 (77%)	.50
Type of screening tools used[a]				N/a
Charlson Comorbidity Index (CCI)	3 (4.5%)	0 (0%)	3 (5.9%)	
American Society of Anesthesiologists (ASA) class	57 (86%)	12 (80%)	45 (88%)	
Outpatient Arthroplasty Risk Assessment (OARA)	1 (1.5%)	0 (0%)	1 (2.0%)	
Total joint replacement (TJR) risk calculator	1 (1.5%)	0 (0%)	1 (2.0%)	
Readmission Risk Assessment Tool (RRAT)	1 (1.5%)	0 (0%)	1 (2.0%)	
Protocollary defined selection criteria	14 (21%)	7 (47%)	7 (14%)	
Other	7 (11%)	3 (20%)	4 (7.8%)	

Discrete variables are given as frequency (percentage).
[a] Multiple answers were allowed. Proportions of respondents that made use of this feature were displayed.

Postoperative checks

Outpatient and inpatient pathways for both hip and knee arthroplasty procedures significantly differed in regime for postoperative hemoglobin (Hb) check ($P < .001$ and $P = .001$, respectively) (Tables 6 and 7).

Table 3
Preoperative characteristics of the outpatient and inpatient knee arthroplasty pathway.

Characteristic	Total	Outpatient	Inpatient	*P* value
Number of respondents	102	16	86	
Preoperative education	102 (100%)	16 (100%)	86 (100%)	N/a
Type of education used[a]				N/a
Verbal	77 (75%)	14 (88%)	63 (73%)	
Informative leaflets	96 (94%)	16 (100%)	80 (93%)	
Videos	43 (42%)	3 (19%)	40 (47%)	
Decision aids	39 (38%)	6 (38%)	33 (38%)	
eHealth (eg, patient journey app)	28 (27%)	4 (25%)	24 (28%)	
Other	5 (4.9%)	1 (6.3%)	4 (4.7%)	
Pre-habilitation	37 (36%)	9 (56%)	28 (33%)	.091
Preoperative screening	81 (79%)	14 (88%)	67 (78%)	.51
Type of screening tools used[a]				N/a
Charlson Comorbidity Index (CCI)	4 (4.9%)	0 (0%)	4 (6.0%)	
American Society of Anesthesiologists (ASA) class	73 (90%)	12 (86%)	60 (90%)	
Outpatient Arthroplasty Risk Assessment (OARA)	1 (1.2%)	0 (0%)	1 (1.5%)	
Total joint replacement (TJR) risk calculator	2 (2.5%)	0 (0%)	2 (3.0%)	
Readmission Risk Assessment Tool (RRAT)	1 (1.2%)	0 (0%)	1 (1.5%)	
Protocollary defined selection criteria	22 (27%)	6 (43%)	16 (24%)	
Other	8 (9.9%)	3 (21%)	5 (7.5%)	

Discrete variables are given as frequency (percentage).
[a] Multiple answers were allowed. Proportions of respondents that made use of this feature were displayed.

Table 4
Intraoperative characteristics of the outpatient and inpatient hip arthroplasty pathway.

Characteristic	Total	Outpatient	Inpatient	*P* value
Number of respondents	83	17	66	
Anesthesia, preference				.55
General	13 (16%)	2 (12%)	11 (17%)	
Spinal with sedation	28 (34%)	6 (35%)	22 (33%)	
Spinal	34 (41%)	9 (53%)	25 (38%)	
No preference	7 (8.4%)	0 (0%)	7 (11%)	
Other	1 (1.2%)	0 (0%)	1 (1.5%)	
Surgical approach, preference				.057
Posterolateral	48 (58%)	6 (35%)	42 (64%)	
Direct anterior	29 (35%)	9 (53%)	19 (29%)	
Straight lateral	3 (3.6%)	0 (0%)	3 (4.5%)	
Anterolateral	1 (1.2%)	1 (5.9%)	0 (0%)	
Direct superior	3 (3.6%)	1 (5.9%)	2 (3.0%)	
Peripheral nerve blocks				.8
Lumbar plexus block	1 (1.2%)	0 (0%)	1 (1.5%)	
Fascia iliaca block	1 (1.2%)	0 (0%)	1 (1.5%)	
Other	2 (2.4%)	0 (0%)	2 (3.0%)	
No	79 (95%)	17 (100%)	62 (94%)	
LIA use	6 (7.2%)	1 (5.9%)	5 (7.6%)	1.0
Composition of LIA used[a]				N/a
Ropivacaine	5 (83%)	1 (100%)	4 (80%)	
Bupivacaine	1 (17%)	0 (0%)	1 (20%)	
Adrenaline	2 (33%)	0 (0%)	2 (40%)	
Tranexamic acid use	83 (100%)	17 (100%)	66 (100%)	N/a
When				.091
Preoperative	28 (34%)	3 (17%)	25 (38%)	
Intraoperative	9 (11%)	0 (0%)	9 (14%)	
Postoperative	3 (3.6%)	0 (0%)	3 (4.5%)	
Preoperative and intraoperative	14 (17%)	3 (17%)	11 (17%)	
Preoperative and postoperative	21 (25%)	8 (47%)	13 (20%)	
Intraoperative and postoperative	4 (4.8%)	2 (12%)	2 (3.0%)	
Preoperative, intraoperative and postoperative	4 (4.8%)	1 (5.9%)	3 (4.5%)	
How				**<.001**
Oral	3 (3.6%)	2 (12%)	1 (1.5%)	
Intravenous	61 (73%)	6 (35%)	55 (83%)	
Intra-articular	0 (0%)	0 (0%)	0 (0%)	
Oral and intravenous	11 (13%)	8 (47%)	3 (4.5%)	
Intravenous and intra-articular	7 (8.4%)	1 (5.9%)	6 (9.1%)	
I don't know	1 (1.2%)	0 (0%)	1 (1.5%)	
Drain use	1 (1.2%)	0 (0%)	1 (1.5%)	1.0
Urinary catheter use	2 (2.4%)	0 (0%)	2 (3.0%)	1.0
Antibiotics				**<.001**
1 dose	13 (16%)	2 (12%)	11 (17%)	
2 doses	11 (13%)	9 (53%)	2 (3.0%)	
3 doses	58 (70%)	6 (35%)	52 (79%)	
Other	1 (1.2%)	0 (0%)	1 (1.5%)	

LIA, local infiltration anesthesia.
Discrete variables are given as frequency (percentage); bold values indicate statistically significant difference ($P < .05$).
[a] Multiple answers were allowed. Proportions of respondents that made use of this feature were displayed.

Table 5
Intraoperative characteristics of the outpatient and inpatient knee arthroplasty pathway.

Characteristic	Total	Outpatient	Inpatient	*P* value
Number of respondents	102	16	86	
Anesthesia, preference				.43
General	5 (4.9%)	0 (0%)	5 (5.8%)	
Spinal with sedation	36 (35%)	7 (44%)	29 (34%)	
Spinal	40 (39%)	8 (50%)	32 (37%)	
No preference	18 (18%)	1 (6.3%)	17 (20%)	
Other	3 (2.9%)	0 (0%)	3 (3.5%)	
Surgical approach, preference				.061
Medial parapatellar	100 (98%)	15 (94%)	85 (99%)	
Midvastus	1 (0.98%)	1 (6.3%)	0 (0%)	
Subvastus	1 (0.98%)	0 (0%)	1 (1.2%)	
Tourniquet use	46 (45%)	6 (38%)	40 (47%)	.51
Technique				.22
During the entire operation	32 (70%)	6 (100%)	26 (65%)	
During cementation	11 (24%)	0 (0%)	11 (28%)	
Other	3 (6.5%)	0 (0%)	3 (7.5%)	
Peripheral nerve blocks				.30
Femoral nerve block	8 (7.8%)	0 (0%)	8 (9.3%)	
Saphenous nerve (adductor canal) block	8 (7.8%)	0 (0%)	8 (9.3%)	
Obturator nerve block	1 (0.98%)	0 (0%)	1 (1.2%)	
Other	4 (3.9%)	0 (0%)	4 (4.7%)	
No	81 (79%)	16 (100%)	65 (76%)	
LIA use	98 (96%)	16 (100%)	82 (95%)	1.0
Composition of LIA used[a]				N/a
Ropivacaine	85 (87%)	15 (94%)	70 (85%)	
Bupivacaine	13 (13%)	1 (6.3%)	12 (15%)	
Ketorolac	4 (4.1%)	1 (6.3%)	3 (3.7%)	
Adrenaline	31 (32%)	3 (19%)	28 (34%)	
Morphine	1 (1.0%)	0 (0%)	1 (1.2%)	
Corticosteroids	3 (3.1%)	1 (6.3%)	2 (2.4%)	
Don't know	2 (2.0%)	0 (0%)	2 (2.4%)	
Other	1 (1.0%)	0 (0%)	1 (1.2%)	
Tranexamic acid use	102 (100%)	16 (100%)	86 (100%)	N/a
When				.052
Preoperative	35 (34%)	2 (13%)	33 (38%)	
Intraoperative	12 (12%)	0 (0%)	12 (14%)	
Postoperative	2 (2.0%)	0 (0%)	2 (2.3%)	
Preoperative and intraoperative	16 (16%)	3 (19%)	13 (15%)	
Preoperative and postoperative	28 (27%)	8 (50%)	20 (23%)	
Intraoperative and postoperative	4 (3.9%)	2 (13%)	2 (2.3%)	
Preoperative, intraoperative and postoperative	5 (4.9%)	1 (6.3%)	4 (4.7%)	
How				**.002**
Oral	6 (5.9%)	1 (6.3%)	5 (5.8%)	
Intravenous	72 (71%)	6 (38%)	66 (77%)	
Intra-articular	0 (0%)	0 (0%)	0 (0%)	
Oral and intravenous	15 (15%)	8 (50%)	7 (8.1%)	
Intravenous and intra-articular	7 (6.9%)	1 (6.3%)	6 (7.0%)	
Oral, intravenous and intra-articular	1 (0.98%)	0 (0%)	1 (1.2%)	
I don't know	1 (0.98%)	0 (0%)	1 (1.2%)	
Drain use	2 (2.0%)	0 (0%)	2 (2.3%)	1.0
Urinary catheter use	2 (2.0%)	0 (0%)	2 (2.3%)	1.0
Antibiotics				**.014**
1 dose	17 (17%)	1 (6.3%)	16 (19%)	
2 doses	17 (17%)	7 (44%)	10 (12%)	
3 doses	66 (65%)	8 (50%)	58 (67%)	
Other	2 (2.0%)	0 (0%)	2 (2.3%)	

LIA, local infiltration anesthesia.
Discrete variables are given as frequency (percentage); bold values indicate statistically significant difference ($P < .05$).
[a] Multiple answers were allowed. Proportions of respondents that made use of this feature were displayed.

Discussion

Optimization of clinical pathways and logistics led to the introduction of OJA. This study aimed to find protocollary differences between outpatient and inpatient joint arthroplasty pathways. Only slight differences were found in both the intraoperative and postoperative phases and probably relied mainly on logistical grounds to ensure efficient same-day discharge. In addition, we found no significantly different LOS for “standard” inpatients in both groups (orthopedic surgeons who performed both inpatient and outpatient vs inpatient alone), suggesting that many existing inpatient pathways might not be far removed from OJA, and OJA is most likely underutilized nationally [12].

Preoperative characteristics

Preoperative patient education is not only mandatory to obtain informed consent but also important as it can serve multiple purposes [13]: (1) Adequate information may motivate patients to

Table 6
Postoperative characteristics of the outpatient and inpatient hip arthroplasty pathway.

Characteristic	Total	Outpatient	Inpatient	*P* value
Number of respondents	83	17	66	
Average length of stay after standard inpatient THA (days)[a]	2.1 ± 0.80 (1-6)	2.1 ± 0.66 (1-3)	2.1 ± 0.84 (1-6)	.73
Anticoagulant use	83 (100%)	17 (100%)	66 (100%)	N/a
Preferences[b]				N/a
Low-molecular-weight heparins (LMWHs)	66 (80%)	14 (82%)	52 (79%)	
Novel oral anticoagulants (NOACs)/Direct oral anticoagulants (DOACs)	24 (29%)	4 (24%)	20 (30%)	
Platelet aggregation inhibitor	2 (2.4%)	0 (0%)	2 (3.0%)	
Length of use				.12
1-3 weeks	2 (2.4%)	1 (5.9%)	1 (1.5%)	
4-6 weeks	77 (93%)	15 (88%)	62 (94%)	
>6 weeks	1 (1.2%)	1 (5.9%)	0 (0%)	
Other	3 (3.6%)	0 (0%)	3 (4.5%)	
Morphine use				.42
Rescue medication	48 (58%)	12 (71%)	36 (55%)	
Standard/scheduled medication	26 (31%)	4 (24%)	22 (33%)	
Patient controlled analgesia	5 (6.0%)	0 (0%)	5 (7.6%)	
No	2 (2.4%)	0 (0%)	2 (3.0%)	
Other	2 (2.4%)	1 (5.9%)	1 (1.5%)	
Physical therapy				**.034**
On the same day	67 (81%)	17 (100%)	50 (76%)	
Not the same day if surgery takes place later on the day	16 (19%)	0 (0%)	16 (24%)	
Hb check				**<.001**
Always	54 (65%)	4 (24%)	50 (76%)	
Only if indicated	28 (34%)	12 (71%)	16 (24%)	
No	1 (1.2%)	1 (5.9%)	0 (0%)	
X-ray				.19
Direct postoperative	77 (93%)	15 (88%)	62 (94%)	
During follow-up visit	2 (2.4%)	0 (0%)	2 (3.0%)	
Only if indicated	1 (1.2%)	0 (0%)	1 (1.5%)	
Other	3 (3.6%)	2 (12%)	1 (1.5%)	

Discrete variables are given as frequency (percentage), and continuous variables as mean ± standard deviation (range); bold values indicate statistically significant difference ($P < .05$).

[a] Both groups of orthopedic surgeons (performing both inpatient and outpatient joint arthroplasty vs only inpatient joint arthroplasty) estimated their average LOS for the standard inpatient total joint pathways.

[b] Multiple answers were allowed. Proportions of respondents that made use of this feature were displayed.

Table 7
Postoperative characteristics of the outpatient and inpatient knee arthroplasty pathway.

Characteristic	Total	Outpatient	Inpatient	*P* value
Number of respondents	102	16	86	
Average length of stay after standard inpatient TKA (days)[a]	2.3 ± 0.85 (1-6)	2.1 ± 0.62 (1-3)	2.3 ± 0.89 (1-6)	.51
Anticoagulant use	102 (100%)	16 (100%)	86 (100%)	N/a
Preferences[b]				N/a
Low-molecular-weight heparins (LMWHs)	83 (81%)	14 (81%)	69 (80%)	
Novel oral anticoagulants (NOACs)/Direct oral anticoagulants (DOACs)	27 (26%)	2 (13%)	25 (29%)	
Platelet aggregation inhibitor	6 (5.9%)	1 (6.3%)	5 (5.8%)	
Mechanic (elastic compression stockings)	1 (0.98%)	0 (0%)	1 (1.2%)	
Length of use				**.043**
1-3 weeks	2 (2.0%)	1 (6.3%)	1 (1.2%)	
4-6 weeks	94 (92%)	14 (88%)	80 (93%)	
>6 weeks	1 (0.98%)	1 (6.3%)	0 (0%)	
Other	5 (4.9%)	0 (0%)	5 (5.8%)	
Morphine use				.40
Rescue medication	58 (57%)	11 (69%)	47 (55%)	
Standard/scheduled medication	35 (34%)	4 (25%)	31 (36%)	
Patient controlled analgesia	6 (5.9%)	0 (0%)	6 (7.0%)	
No	1 (0.98%)	0 (0%)	1 (1.2%)	
Other	2 (2.0%)	1 (6.3%)	1 (1.2%)	
Continuous passive motion device, use	2 (2.0%)	0 (0%)	2 (2.3%)	1.0
Physical therapy				.15
On the same day	85 (83%)	16 (100%)	69 (80%)	
Not the same day if surgery takes place later on the day	16 (16%)	0 (0%)	16 (19%)	
Other	1 (0.98%)	0 (0%)	1 (1.2%)	
Hb check				**.001**
Always	66 (65%)	4 (25%)	62 (72%)	
Only if indicated	36 (35%)	12 (75%)	24 (28%)	
X-ray				.54
Direct postoperative	99 (97%)	15 (94%)	83 (97%)	
During follow-up visit	1 (0.98%)	0 (0%)	1 (1.2%)	
Only if indicated	1 (0.98%)	0 (0%)	1 (1.2%)	
Other	2 (2.0%)	1 (6.3%)	1 (1.2%)	

Discrete variables are given as frequency (percentage), and continuous variables as mean ± standard deviation (range); bold values indicate statistically significant difference ($P < .05$).

[a] Both groups of orthopedic surgeons (performing both inpatient and outpatient joint arthroplasty vs only inpatient joint arthroplasty) estimated their average LOS for the standard inpatient total joint pathways.

[b] Multiple answers were allowed. Proportions of respondents that made use of this feature were displayed.

actively participate, adhere to the protocol, and increase their sense of responsibility for a successful surgery [14]; (2) manage and modulate expectations as this is associated with patient satisfaction [15]; and (3) reduce preoperative anxiety related to the upcoming surgical event [14,16]. The format of education can range from conventional (verbal one-to-one/group sessions, written) to more innovative methods (audiovisual, decision aids, and eHealth). Interestingly, we found that informative brochures (94%) and verbal education (~75%) were the most common used forms of preoperative education, whereas the use of decision aids (~40%) and eHealth (~30%) was relatively scarce. Although OJA might be considered more innovative than standard inpatient pathways, no significant differences in the use of innovative preoperative education types were found between the 2 pathways.

In outpatient pathways, respondents were more likely to use (self) predefined selection criteria. This makes sense as, to date, evidence suggests that OJA should be reserved for selected patients [9], and therefore, selection criteria were formulated by various research groups [17,18]. However, interestingly we found that, except for ASA classifications, specific screening tools [19] were hardly used in both pathways.

Although not statistically significant, prehabilitation was more frequently applied in outpatient than in inpatient hip and knee pathways. Evidence suggests that preoperative health status is a strong predictor of good postoperative outcome following joint replacement, and as function often tends to deteriorate in the preoperative period, surgeons have the opportunity to optimize patient's health status in preparation for surgery. Although prior systematic reviews found conflicting effectiveness of prehabilitation, recent studies found that preoperative interventions (ie, exercise/educational) significantly improved pain perception, function/quadriceps strength, and reduced LOS [20]. We believe that the concept of prehabilitation can be broadened beyond functional improvement alone and should also focus on other components (eg, management of comorbidities, nutritional status, and addressing mental health problems such as depression/anxiety and negative coping strategies) [21].

Intraoperative characteristics

Spinal anesthesia was most frequently used in both outpatient and inpatient pathways. Traditionally, spinal anesthesia has been advocated over general anesthesia. However, high-quality studies comparing these anesthesia types in patients undergoing fast-track or outpatient TJA are lacking. Recent randomized controlled trials by Harsten et al. even failed to demonstrate differences in functional recovery, LOS, urinary complications, and early mobilization, questioning whether the assumed benefits of spinal anesthesia in reducing morbidity is relevant in this specific patient population and a setting with already optimized perioperative care [22]. This suggests that both general anesthetics (ie, modern targeted total intravenous anesthetic and infusions targeted to anesthetic depth) and neuraxial techniques may be used as part of multimodal anesthetic regimens and should be based on institution's preferences, resources, and skills available [13,23]. In spinal anesthesia, it is important to use a fast-onset and short-duration local anesthetic that advocates early mobilization. Our questionnaire however did not distinguish between the use of local anesthetics in either joint arthroplasty pathways.

LIA was mainly used by respondents performing TKA. A systematic review by Andersen and Kehlet found that LIA was effective in pain reduction, opioid consumption, and LOS, only in TKA [13,24]. Although not supported by the concept of LIA, findings in a study by Keulen et al. suggested that LIA in TKA might compromise early mobilization and same-day discharge by transient common peroneal nerve palsy [6]. Extra cautiousness when injecting LIA in the posterolateral joint capsule was suggested. No undisputed evidence regarding the mixture and dosage of drugs is available, which explains the variability in practices.

Interestingly, PNBs were rarely used by respondents in both pathways for hip and knee arthroplasty. This may be explained by the fact that nerve block was not recommended by the Dutch guidelines and not considered an essential ERAS component by the ERAS Society [13,25]. Although the Dutch guideline has been revised quite recently, it only compared LIA with femoral nerve blocks for TKA. In outpatient pathways, surgeons might have been afraid that blocks interfered with early ambulation, physical therapy, and same-day discharge [26]. With growing evidence demonstrating the effectiveness of "pure sensory" PNBs such as adductor canal block, we might see a change in (Dutch) practice within the next decade [27,28].

The PL approach in THA was most commonly used by our respondents. This is consistent with previous findings [29]. However, the last decade, the DAA gained popularity among orthopedic surgeons, as it is considered muscle-sparing and thought to be associated with less pain, a faster recovery, shorter LOS, and reduced risk of dislocations. This might explain why respondents who perform OJA are more likely to use the DAA. Selection bias may also play a role given the technically challenging nature of the DAA, favoring patients that are also suitable for OJA. However, systematic reviews and meta-analyses are conflicting and, to date, fail to prove the superiority of DAA over other surgical approaches [30,31].

The MMP approach has been the standard in most cases of TKA. Interestingly, none of the respondents preferred minimally invasive surgery approaches (eg, mini-MMP/subvastus/midvastus). Evidence suggests that minimally invasive surgery in TKA might result in a faster functional recovery (and a better early range of motion) but was also associated with wound-healing problems and infections [32].

Although not statistically significant, tourniquet-assisted TKA was less common in outpatient pathways than in inpatient pathways. Evidence suggests that tourniquet-assisted TKA does not reduce total blood loss and may impair early postoperative recovery by pain, swelling, and compromised quadriceps function. A recent study also showed that the use of a tourniquet was associated with higher postoperative pain and an increased risk of serious adverse events (thromboembolic events, infection, and reoperation) [33].

Strong evidence exists on the effectiveness and safety of TXA use in TJA to minimize intraoperative blood loss and transfusion rates [34]. However, significant differences in the regimes (ie, route of administration) were found between outpatient and inpatient pathways. Studies found that all routes of administration (oral, intra-articular, and intravenous) were significantly effective compared with routine hemostasis, and no differences between administration routes were found [35]. A combined administration regimen of TXA methods, however, is supposed to be superior to single administration [36]. The latter was used more often in outpatient hip and knee arthroplasty pathways.

Results showed that outpatient pathways more often included 2 doses of antibiotics, whereas inpatients pathways more often included 3 doses (24-hour span). A recent study found that even single-dose antibiotic prophylaxis is as effective in reducing the risk of periprosthetic joint infections, suggesting that the reduction of antibiotic doses can be safely done in order to optimize pathway logistics [37].

Postoperative characteristics

No significant differences were found between both pathways in terms of opioid use and antithrombotic prophylaxis preference and duration. Interestingly, we found relatively high proportions of standard/scheduled opioids or patient-controlled analgesia in both pathways (relatively more in inpatient than outpatient), and this seems very contradictory to the well-founded opioid-sparing multimodal anesthetic regimen for fast-track and OJA. We advise multidisciplinary teams to address this feature in order to optimize their pathway [13].

The Dutch national guidelines advised thromboprophylaxis with a low-molecular-weight heparin for a period of 4 to 6 weeks after THA and TKA [38,39]. However, guidelines have been developed based on outdated studies with treatment algorithms different from the fast-track methodology. More recent studies suggested a more patient-tailored approach as the incidence of thromboembolic events were substantially lower in a fast-track setting [40]. A recent study even found that "in-hospital only" prophylaxis for patients staying less than 5 days in the hospital was safe [41]. In terms of antithrombotic agent, more recent literature even advocates ASA monotherapy in certain groups of patients [42-44].

Consensus exists patients should be mobilized as early as possible postoperatively to achieve early discharge [13,45]. We found that in ~20% of inpatient pathways, mobilization was delayed to the next day if surgery took place later that day. We hypothesize that logistics (eg, the reduced availability of physical therapists and nurses during after-work hours) and proper titration of anesthesia are main reasons for this delay and is rarely a problem in outpatient pathways because patients will be mainly operated first or second of the day [6]. Also, for a well-established inpatient joint arthroplasty pathway, we strongly recommend the multidisciplinary team to optimize logistics so that all patients are mobilized by the physical therapist on the day of the operation (also after work hours), regardless of the planned operating time [13,45].

Significant differences in postoperative regime for Hb-check were found between outpatient pathways (check only on indication) and inpatient pathways (standard check). Because of the standard use of TXA in present perioperative care, the blood loss and transfusion rates are dramatically reduced. Therefore,

patients—that are often subject to strict selection criteria in OJA—that underwent uncomplicated TJA probably have a negligible risk for transfusion need [46].

Strengths and limitations

To the best of our knowledge, this is the first study that assessed differences between outpatient and inpatient arthroplasty pathways in detail. The results represent the Dutch practice and therefore limits external validity to countries with different healthcare systems or less experience in TJA pathway innovation. While interpreting the results, one should also take into account that guidelines and consensus statements for perioperative care in THA and TKA may be different internationally. The survey was designed by a multidisciplinary team including high-volume hip and knee orthopedic surgeons, researchers, physician assistants, and an epidemiologist. A good sample size was achieved, including surgeons who were a member of either the Dutch Hip Society or Dutch Knee Society (focus groups of the Dutch Orthopeadic Association). Although the overall response rate seems low, the literature shows that the response rate was above average as physicians are often a group with a low survey response rate to web-based surveys [47,48]. Moreover, if we focus at the response rate of our follow-up survey, it is very high at 95%. Yet our results may possess a risk for selection bias in favor of orthopedic surgeons who have more affinity with clinical pathway optimization for TJA.

Conclusions

In conclusion, significant differences between current outpatient and standard inpatient pathways for TJA in The Netherlands were found only in the intraoperative (administration regimes of TXA and antibiotic prophylaxis) and postoperative phase (postoperative mobilization regime in THA, duration of thromboembolic prophylaxis in TKA, and the need for postoperative Hb checks). These differences probably relied mainly on logistical grounds to ensure efficient same-day discharge in outpatient pathways. Our findings also suggested that OJA pathway may be underutilized in the Netherlands and informs orthopedic surgeons and their multidisciplinary team that formulating selection criteria for eligible patients and the logistical optimization of an already successful inpatient pathway may be the key factor for a successful OJA implementation.

Conflicts of interest

B.B. and R.P.M.H. is in the speakers' bureau of/gave paid presentations for and is a paid consultant for Zimmer Biomet. All other authors have nothing to disclose.

For full disclosure statements refer to https://doi.org/10.1016/j.artd.2024.101343.

CRediT authorship contribution statement

Mark H.F. Keulen: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Validation, Writing – original draft, Writing – review & editing. **Yoeri F.L. Bemelmans:** Conceptualization, Data curation, Methodology, Writing – review & editing, Writing – original draft. **B. Boonen:** Conceptualization, Data curation, Investigation, Methodology, Project administration, Supervision, Validation, Writing – original draft, Writing – review & editing, Formal analysis. **Roel P.M. Hendrickx:** Conceptualization, Data curation, Methodology, Writing – original draft, Writing – review & editing. **Ide C. Heyligers:** Conceptualization, Data curation, Methodology, Writing – original draft, Writing – review & editing. **Martijn G.M. Schotanus:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Supervision, Validation, Writing – original draft, Writing – review & editing.

References

[1] Van Herck P, Vanhaecht K, Deneckere S, Bellemans J, Panella M, Barbieri A, et al. Key interventions and outcomes in joint arthroplasty clinical pathways: a systematic review. J Eval Clin Pract 2010;16:39–49.

[2] Kehlet H. Multimodal approach to control postoperative pathophysiology and rehabilitation. Br J Anaesth 1997;78:606–17.

[3] Kehlet H. Fast-track hip and knee arthroplasty. Lancet 2013;381:1600–2.

[4] Zhu S, Qian W, Jiang C, Ye C, Chen X. Enhanced recovery after surgery for hip and knee arthroplasty: a systematic review and meta-analysis. Postgrad Med 2017;93:736–42.

[5] Jones EL, Wainwright TW, Foster JD, Smith JR, Middleton RG, Francis NK. A systematic review of patient reported outcomes and patient experience in enhanced recovery after orthopaedic surgery. Ann R Coll Surg Engl 2014;96:89–94.

[6] Keulen MHF, Asselberghs S, Bemelmans YFL, Hendrickx RPM, Schotanus MGM, Boonen B. Reasons for unsuccessful same-day discharge following outpatient hip and knee arthroplasty: $5^{1}/_{2}$ years' experience from a single institution. J Arthroplasty 2020;35:2327–34.

[7] Coenders MJ, Mathijssen NM, Vehmeijer SB. Three and a half years' experience with outpatient total hip arthroplasty. Bone Joint J 2020;102:82–9.

[8] Goyal N, Chen AF, Padgett SE, Tan TL, Kheir MM, Hopper RH, et al. Otto Aufranc Award: a multicenter, randomized study of outpatient versus inpatient total hip arthroplasty. Clin Orthop Relat Res 2017;475:364–72.

[9] Bemelmans YFL, Keulen MHF, Heymans M, van Haaren EH, Boonen B, Schotanus MGM. Safety and efficacy of outpatient hip and knee arthroplasty: a systematic review with meta-analysis. Arch Orthop Trauma Surg 2022;142:1775–91.

[10] Keulen MHF, Schotanus MGM, van Haaren EH, van Hemert WLW, Heyligers IC, Boonen B. Rates and causes of 90-day complications and readmissions following outpatient hip and knee arthroplasty: a retrospective analysis of 525 patients in a single institution. J Arthroplasty 2021;36:863–78.

[11] Keulen MHF, Most J, Schotanus MGM, van Haaren EH, Heyligers IC, Boonen B. Orthopaedic surgeons' perspective on the implementation of outpatient hip and knee arthroplasty - results of a nationwide survey. J Clin Orthop Trauma 2022;29:101873.

[12] Gromov K, Price A, Mohaddes M, Della Valle C. Outpatient hip and knee arthroplasty:how is it utilized? Acta Orthop 2023;94:511–3.

[13] Wainwright TW, Gill M, McDonald DA, Middleton RG, Reed M, Sahota O, et al. Consensus statement for perioperative care in total hip replacement and total knee replacement surgery: enhanced Recovery after Surgery (ERAS®) Society recommendations. Acta Orthop 2020;91:3–19.

[14] Edwards PK, Mears SC, Lowry Barnes C. Preoperative education for hip and knee replacement: never stop learning. Curr Rev Musculoskelet Med 2017;10:356–64.

[15] Mancuso CA, Graziano S, Briskie LM, Peterson MG, Pellicci PM, Salvati EA, et al. Randomized trials to modify patients' preoperative expectations of hip and knee arthroplasties. Clin Orthop Relat Res 2008;466:424–31.

[16] Spalding NJ. Reducing anxiety by pre-operative education: make the future familiar. Occup Ther Int 2003;10:278–93.

[17] Kort NP, Bemelmans YFL, van der Kuy PH, Jansen J, Schotanus MGM. Patient selection criteria for outpatient joint arthroplasty. Knee Surg Sports Traumatol Arthrosc 2017;25:2668–75.

[18] Keulen MHF, Asselberghs S, Boonen B, Hendrickx RPM, van Haaren EH, Schotanus MGM. Predictors of (Un)successful same-day discharge in selected patients following outpatient hip and knee arthroplasty. J Arthroplasty 2020;35:1986–92.

[19] Ziemba-Davis M, Caccavallo P, Meneghini RM. Outpatient joint arthroplasty—patient selection: update on the outpatient arthroplasty risk assessment score. J Arthroplasty 2019;34:S40–3.

[20] Moyer R, Ikert K, Long K, Marsh J. The value of preoperative exercise and education for patients undergoing total hip and knee arthroplasty: a systematic review and meta-analysis. JBJS Rev 2017;5:e2.

[21] Gylvin SH, Jørgensen CC, Fink-Jensen A, Kehlet H. Psychiatric disease as a risk factor in fast-track hip and knee replacement. Acta Orthop 2016;87:439–43.

[22] Harsten A, Kehlet H, Toksvig-Larsen S. Recovery after total intravenous general anaesthesia or spinal anaesthesia for total knee arthroplasty: a randomized trial. Br J Anaesth 2013;111:391–9.

[23] Johnson RL, Kopp SL, Burkle CM, Duncan CM, Jacob AK, Erwin PJ, et al. Neuraxial vs general anaesthesia for total hip and total knee arthroplasty: a systematic review of comparative-effectiveness research. Br J Anaesth 2016;116:163–76.

[24] Andersen LØ, Kehlet H. Analgesic efficacy of local infiltration analgesia in hip and knee arthroplasty: a systematic review. Br J Anaesth 2014;113:360–74.

[25] Federatie Medisch Specialisten. Richtlijn: Totale Knieprothese (TKP). https://richtlijnendatabase.nl/richtlijn/totale_knieprothese/effect_van_klinische_

paden_bij_tkp/perioperatieve_postoperatieve_pijnbestrijding_bij_tkp.html; 2021. [Accessed 10 July 2023].
[26] Kuang MJ, Ma JX, Fu L, He WW, Zhao J, Ma XL. Is adductor canal block better than femoral nerve block in primary total knee arthroplasty? A GRADE analysis of the evidence through a systematic review and meta-analysis. J Arthroplasty 2017;32:3238–3248.e3.
[27] Osman BM, Tieu TG, Caceres YG, Hernandez VH. Current Trends and future directions for outpatient total joint arthroplasty: a review of the anesthesia choices and analgesic options. J Am Acad Orthop Surg Glob Res Rev 2023;7:e22.00259.
[28] Summers S, Mohile N, McNamara C, Osman B, Gebhard R, Hernandez VH. Analgesia in total knee arthroplasty: current pain control modalities and outcomes. J Bone Joint Surg Am 2020;102:719–27.
[29] Chechik O, Khashan M, Lador R, Salai M, Amar E. Surgical approach and prosthesis fixation in hip arthroplasty world wide. Arch Orthop Trauma Surg 2013;133:1595–600.
[30] Meermans G, Konan S, Das R, Volpin A, Haddad FS. The direct anterior approach in total hip arthroplasty: a systematic review of the literature. Bone Joint J 2017;99:732–40.
[31] Miller LE, Gondusky JS, Bhattacharyya S, Kamath AF, Boettner F, Wright J. Does surgical approach affect outcomes in total hip arthroplasty through 90 days of follow-up? A systematic review with meta-analysis. J Arthroplasty 2018;33:1296–302.
[32] Cheng T, Liu T, Zhang G, Peng X, Zhang X. Does minimally invasive surgery improve short-term recovery in total knee arthroplasty? Clin Orthop Relat Res 2010;468:1635–48.
[33] Ahmed I, Chawla A, Underwood M, Price AJ, Metcalfe A, Hutchinson CE, et al. Time to reconsider the routine use of tourniquets in total knee arthroplasty surgery: an abridged version of a Cochrane systematic review and meta-analysis. Bone Joint J 2021;103:830–9.
[34] Yang ZG, Chen WP, Wu LD. Effectiveness and safety of tranexamic acid in reducing blood loss in total knee arthroplasty: a meta-analysis. J Bone Joint Surg Am 2012;94:1153–9.
[35] Xu S, Chen JY, Zheng Q, Lo NN, Chia SL, Tay KJ, et al. The safest and most efficacious route of tranexamic acid administration in total joint arthroplasty: a systematic review and network meta-analysis. Thromb Res 2019;176:61–6.
[36] Zhang MP, Li MJ, Wang MX. Combined versus single application of tranexamic acid in total knee and hip arthroplasty: a meta-analysis of randomized controlled trials. Int J Surg 2017;43:171–80.
[37] Tan TL, Shohat N, Rondon AJ, Foltz C, Goswami K, Ryan SP, et al. Perioperative antibiotic prophylaxis in total joint arthroplasty: a single dose is as effective as multiple doses. J Bone Joint Surg Am 2019;101:429–37.
[38] Büller HR, van der Meer J, Oudkerk M. CBO-richtlijn 'Diepveneuze trombose en longembolie'; herziening van eerdere richtlijnen [CBO guideline 'Deep venous thrombosis and pulmonary embolism; revision of the earlier guidelines. Dutch Organization for Quality Assurance in Hospitals]. Ned Tijdschr Geneeskd 2000;144:1531–7.
[39] Federatie Medisch Specialisten. Richtlijn: Antitrombotisch Beleid. https://richtlijnendatabase.nl/richtlijn/antitrombotisch_beleid/preventie_vte/start_profylaxe_grote_orthopedische_ingrepen.html; 2016. [Accessed 10 July 2023].
[40] Venclauskas L, Llau JV, Jenny JY, Kjaersgaard-Andersen P, Jans Ø. European guidelines on perioperative venous thromboembolism prophylaxis: day surgery and fast-track surgery. Eur J Anaesthesiol 2018;35:134–8.
[41] Petersen PB, Kehlet H, Jørgensen CC, Lundbeck Foundation Centre for Fast-track Hip and Knee Replacement Collaborative Group. Safety of in-hospital only thromboprophylaxis after fast-track total hip and knee arthroplasty: a prospective follow-up study in 17,582 procedures. Thromb Haemost 2018;118:2152–61.
[42] Azboy I, Barrack R, Thomas AM, Haddad FS, Parvizi J. Aspirin and the prevention of venous thromboembolism following total joint arthroplasty: commonly asked questions. Bone Joint J 2017;99-B:1420–30.
[43] Matharu GS, Kunutsor SK, Judge A, Blom AW, Whitehouse MR. Clinical effectiveness and safety of aspirin for venous thromboembolism prophylaxis after total hip and knee replacement: a systematic review and meta-analysis of randomized clinical trials. JAMA Intern Med 2020;180:376–84.
[44] Wilson DG, Poole WE, Chauhan SK, Rogers BA. Systematic review of aspirin for thromboprophylaxis in modern elective total hip and knee arthroplasty. Bone Joint J 2016;98:1056–61.
[45] Guerra ML, Singh PJ, Taylor NF. Early mobilization of patients who have had a hip or knee joint replacement reduces length of stay in hospital: a systematic review. Clin Rehabil 2015;29:844–54.
[46] Greco NJ, Manocchio AG, Lombardi AV, Gao SL, Adams J, Berend KR. Should postoperative haemoglobin and potassium levels be checked routinely following blood-conserving primary total joint arthroplasty? Bone Joint J 2019;101:25–31.
[47] Cunningham CT, Quan H, Hemmelgarn B, Noseworthy T, Beck CA, Dixon E, et al. Exploring physician specialist response rates to web-based surveys. BMC Med Res Methodol 2015;15:32. https://doi.org/10.1186/s12874-015-0016-z.
[48] Sheehan K. E-mail survey response rates: a review. J Comput Mediat Commun 2001;6:2. https://doi.org/10.1111/j.1083-6101.2001.tb00117.x.