Impeding factors of early rehabilitation postoperatively after rheumatoid toe arthroplasty: a retrospective cohort study

Shunsaku Goto (goto.shunsaku@twmu.ac.jp)
Tokyo Women's Medical University https://orcid.org/0000-0002-2064-6664

Yusuke Kasuya
TMG Asaka Medical MedicalCenter

Keiko Okuyama
Tokyo Women's Medical University

Katsunori Ikari
Tokyo Women's Medical University

Makoto Ozaki
Tokyo Women's Medical University

Research article

Keywords: rheumatoid arthritis, rehabilitation, postoperative pain

Posted Date: April 3rd, 2020

DOI: https://doi.org/10.21203/rs.3.rs-20129/v1

Abstract

Background: It is important to promote early ambulation postoperatively but there are many factors that can hinder the possibility of walking after surgery. Studies have been done to research the benefits related to early ambulation postoperatively but few are focused on patients that have rheumatoid arthritis (RA). We retrospectively investigated the incidence and predictors of the inability to start walking on the first postoperative day (POD) after rheumatoid toe arthroplasty.

Methods: RA patients who underwent toe arthroplasty at an academic teaching hospital were retrospectively reviewed. We divided patients into the two groups: possible group, who were able to walk on the first day postoperatively and impossible group, who were unable to walk on the first day postoperatively. The primary outcome was odds ratio (OR) with a 95% confidence interval (CI) between various patient factors and the impossible group with logistic regression analysis. The post hoc analysis for association between anesthesia methods and postoperative outcome was carried out.

Results: A total of 300 patients were included and divided into two groups: possible group (n = 191) and impossible group (n = 109). The incidence of postoperative nausea and vomiting (PONV) before rehabilitation was significantly associated with the infeasibility of walking rehabilitation on the first POD [OR = 2.43, 95% CI 1.22-4.14, P = 0.003]. The number of rescue analgesics administered before rehabilitation and the supplementation of peripheral nerve block (PNB) was also associated with the infeasibility of walking rehabilitation on the first POD [OR = 1.29, 95% CI 1.04-1.59, P = 0.003], [OR = 0.41, 95% CI 0.20-0.79, P = 0.010], respectively. In the post hoc analysis, incidence of PONV was highly associated with postoperative intravenous continuous opioid (48.7%, P < 0.0001) compared to regional analgesia; PNB (11.3 %) and epidural (26.7%).

Conclusions: In our study, the incidence of PONV and inadequate postoperative pain management hindered early rehabilitation. Adding PNB to general anesthesia had an advantage for postoperative rehabilitation and decreased PONV after rheumatoid toe surgery.

Background

Early rehabilitation is beneficial for rheumatoid arthritis (RA) patients, as it shortens the hospital stay (1), and reduces the chances of infection (2). Rehabilitation is affected by several factors such as postoperative pain, postoperative nausea and vomiting (PONV), anesthesia methods, the type of surgery, and disease severity. For rheumatoid toe arthroplasty, there are several anesthesia methods. Regional anesthesia for major knee surgery showed better improvement than general anesthesia (GA) in postoperative rehabilitation (3, 4). However, these studies were carried out in non-rheumatoid arthritis populations.

RA patients have different characteristics when compared with non-RA patients in terms of postoperative outcomes. They are more likely to have worse preoperative and postoperative pain (5), longer hospital stay after surgery (1), and the majority of RA patients are younger women with a higher risk of PONV.

We hypothesized postoperative management and anesthesia methods would affect postoperative rehabilitation in RA patients. The purpose of the present study was to investigate predictors of the inability to walk in rehabilitation after rheumatoid toe arthroplasty.

Materials And Methods

The present study was approved by the Institutional Review Board of Tokyo Women's Medical University (approval number 4416, July 11, 2017). The need for informed consent was waived by the Review Board due to the retrospective nature of the study. The protocol was registered at the UMIN Clinical Trials Registry (No: UMIN000038476).We retrospectively reviewed all medical records of patients with RA who underwent toe arthroplasty at our institute between January 2014 and May 2018.

The inclusion criteria were as follows: patients aged 20 years or older, patients with prior diagnosis of RA, patients who underwent elective toe arthroplasty, patients who were scheduled for their first postoperative day (POD) rehabilitation. We categorized patients into the two groups: possible group, those who were able to walk during rehabilitation on the first POD and impossible group, those who were unable to walk during rehabilitation on the first POD.

The primary outcome was odds ratio (OR) with a 95% confidence interval (CI) between various patient factors and the infeasibility of walking rehabilitation on the first POD. The secondary outcome measures were time until the first rescue analgesic requirement after the surgery and the incidence of PONV after each anesthesia method. The post hoc analysis for association between anesthesia methods and postoperative outcome was planned in advance.

Patients’ demographic data including age, sex, height, body weight, preoperative medication for RA were collected by reviewing the medical records. Intraoperative data such as duration of anesthesia and surgery, anesthesia methods, blood loss and fluid infusion, total amount of intraoperative fentanyl were collected from the electronic anesthesia record system Mirrel (FUKUDA DENSHI, Tokyo).

There was a wide variety of anesthesia modalities: GA or non-GA, type of regional anesthesia (spinal, epidural or combined spinal-epidural anesthesia), supplementation of peripheral nerve block (PNB) and continuous postoperative opioid.

The GA was managed using remifentanil, fentanyl, propofol, sevoflurane, and desflurane. The type and dose of the anesthesia medication depended on the decision of the anesthesiologists in charge. The continuous postoperative intravenous patient controlled analgesia (IVPCA) was managed by fentanyl (base 15 or 20 μg / hour, bolus of 15 or 20 μg, and lockout interval of 10 minutes). Epidural catheter was placed at the L2-L3, L3-L4, L4-L5, or L5/S1 intervertebral space. Patient-controlled epidural analgesia consisted of 0.25% levobupivacaine (base dose of 4 ml / hour, bolus of 4 ml, and lockout interval of 30 minutes). The method of single injection PNB was mainly a combination of popliteal sciatic nerve and femoral or subsartorial saphenous nerve block with 20–40 mL of 0.375-0.5% ropivacaine or 0.25% levobupivacaine using ultrasound-guided technique. Two patients managed by ankle block with 30 ml of

0.5% ropivacaine using ultrasound-guided technique. The combined spinal-epidural anesthesia was administered epidural anesthesia at the L2-L3, L3-L4, or L4-L5 intervertebral space and spinal anesthesia at the L3-L4 or the L4-L5 intervertebral space with 2.2-4 ml of 0.5% hyperbaric or plain bupivacaine. The spinal anesthesia was administered at the L3-L4 or the L4-L5 intervertebral space with 2.2-4 ml of 0.5% hyperbaric or plain bupivacaine.

Postoperative pain was managed by uniform clinical pathway: there was no regular administration of analgesics, and additional analgesics were administered by the nurse at the patient request. IVPCA with fentanyl and patient-controlled epidural analgesia bolus was not counted as the number of rescue analgesia.

Data are presented as mean (standard deviation), median [interquartile range], or number (%). Categorical variables were compared using the chi-squared test and numerical variables were compared using Student's t-test for the parametric data and Mann–Whitney U test for the non-parametric data.

The primary outcome was assessed using logistic regression analysis and the p value was calculated with the Benjamini-Hochberg method. We considered that patient factors such as physique, age, sex, daily use of corticosteroid, the number of biological disease modifying anti-rheumatic drugs (DMARDs), surgical factors (duration of surgery and blood loss), anesthesia factors (duration of anesthesia, intraoperative fluid volume, anesthesia methods and intraoperative fentanyl dose), and postoperative factors (postoperative continuous opioid use, postoperative pain and PONV) hindered postoperative rehabilitation, and comprehensively examined them using logistic regression analysis.

Time to the first rescue analgesic requirement after the surgery was compared using the log-rank test and the Kaplan-Meier curve. The incidence of PONV was compared by analysis of variance. Data were analyzed using JMP® Pro 15.0.0 (SAS, Cary, NC, USA). A P value < 0.05 was considered statistically significant.

Results

During the study period, 326 patients were reviewed and 300 patients were included in the analysis (Fig. 1) and 36.3% of patients were unable to walk during rehabilitation on the first POD; possible group (n = 191), and impossible group (n = 109).

Patients’ demographic and perioperative data are shown in Table 1. No significant differences were observed in age, sex, height, or body weight among the two groups. The number of preoperative anti-rheumatic drugs, prednisolone and DMARDs, were similar among the two groups. The proportion managed with PNB was higher in the possible group than in the impossible group, and the incidence of PONV and the number of rescue analgesics administered before rehabilitation was lower. Almost all rescue analgesics were either intravenous flubiprofen or diclofenac suppository.

Table 1
Patients' demographic and perioperative data

Variables	Possible group	Impossible group	P value
N	191	109	
Age (years)	63.7 (10.6)	62.1 (10.1)	0.20
Male/female	14/177	4/105	0.20
Height (cm)	155.2 (7.2)	156.1 (7.2)	0.30
Weight (kg)	51.3 (9.0)	51.3 (8.6)	0.99
Medicine			
Daily prednisolone medication, n (%)	81 (42.4%)	36 (33.0)	0.11
The number of DMARDs taken by patients	1 [1–2]	1 [1–2]	0.37
Duration of surgery	102.2 (37.4)	109.6 (34.1)	0.09
Duration of anesthesia (min)	154.4 (42.3)	162.3 (39.5)	0.11
Intraoperative fluid volume (ml)	918.4 (306.6)	1000.5 (329.5)	0.03
Blood loss (g)	2.3 (5.3)	3.9 (8.0)	0.03
Anesthesia methods			
General anesthesia, n (%)	160 (83.8%)	89 (81.7%)	0.64
Regional anesthesia, n (%)	105 (55.0%)	47 (43.1%)	0.05
Epidural anesthesia, n (%)	28 (14.7%)	21 (19.3%)	0.30
Spinal anesthesia, n (%)	31 (16.3%)	20 (18.3%)	0.64
Peripheral nerve block, n (%)	58 (30.1%)	13 (11.9%)	0.0003
Intraoperative fentanyl dose (μg)	250 [0–400]	300 [50–400]	0.14
Postoperative fentanyl use, n (%)	75 (39.3%)	57 (52.3%)	0.03
Incidence of PONV before rehabilitation, n (%)	42 (22.0%)	47 (43.1%)	0.0001
The number of rescue analgesics administered before rehabilitation	1 [0–1]	1 [0–2]	0.01

Data are presented as mean (SD), median [interquartile range], or number (%). DMARDs: disease-modifying anti-rheumatic drugs, PONV: postoperative nausea and vomiting.

The primary outcome is shown in Table 2. The incidence of PONV before rehabilitation was significantly associated with the infeasibility of walking rehabilitation on the first POD (OR: 2.43; 95% CI 1.44–4.14; P = 0.003). The number of rescue analgesics administered before rehabilitation was associated with the infeasibility of walking rehabilitation on the first POD (OR 1.29 ; 95% CI 1.04–1.59; P = 0.018). PNB was also associated with the infeasibility of walking rehabilitation on the first POD (OR: 0.41; 95% CI 0.20–0.79; P = 0.010). The secondary outcomes are shown in Table 2.

Table 2
Primary and Secondary outcomes

Primary outcome **Logistic regression analysis for the infeasibility of walking rehabilitation on the first POD**			
Variables	Odds ratio	95% CI	P value
Incidence of PONV before rehabilitation	2.43	1.44–4.14	0.003*
Peripheral nerve block	0.41	0.20–0.79	0.010*
The number of rescue analgesics administered before rehabilitation	1.29	1.04–1.59	0.018*
Secondary outcome			
Variables	possible group	impossible group	P value
N	191	109	
Time to the first rescue analgesic requirement (min), median [interquartile range]	1320 [528 – no use]	1046 [366–1897]	0.03
The number of rescue analgesics administered during the first 3 PODs median [interquartile range]	1 [0–3]	3 [1–5]	0.004
*Calculated with the Benjamini-Hochberg method.			
Secondary outcome are presented as median [interquartile range]. POD: postoperative day, CI: confidence interval, PONV: postoperative nausea and vomiting.			
Survival curve of the first pain rescue after the surgery is shown in Fig. 2. Median survival time to the first pain rescue was longer in the possible group compared to the impossible group (1320 min vs. 1046 min, p = 0.03). The number of rescue analgesics during the first 3 PODs was lower in the possible group than in the impossible group (1 [0–3] vs. 3 [1–5], P = 0.004). The post hoc analysis is shown in Table 3. Among the four anesthesia methods (GA, GA + IVPCA with fentanyl, GA + epidural anesthesia, GA + PNB), GA + PNB had the lowest ratio of PONV (11.3%, P < 0.0001) and the infeasibility of walking rehabilitation (17.7%, P = 0.0029).			

Table 3
Post hoc analysis between anesthesia methods and postoperative outcome

Anesthesia methods	GA	GA + IVPCA	GA + Epi	GA + PNB	P value
N	33	115	30	62	
The infeasibility of walking rehabilitation on the first POD	11 (33.3%)	51 (44.3%)	14 (46.7%)	11 (17.7%)	0.0029
Incidence of PONV before rehabilitation, n (%)	7 (21.2%)	56 (48.7%)	8 (26.7%)	7 (11.3%)	< 0.0001
The number of rescue analgesics administered during the first 3 PODs	1 [1–4]	1 [0–4]	1 [0–3.25]	2[0–3]	0.32

Data are presented as median [interquartile range], or number (%). GA: general anesthesia, IVPCA: intravenous patient-controlled analgesia, Epi: epidural anesthesia, PNB: peripheral nerve block, POD: postoperative day, PONV: postoperative nausea and vomiting

Discussion

The present study showed that, in RA patients who underwent toe arthroplasty, the incidence of PONV and inadequate postoperative pain management were predictors for the infeasibility of walking rehabilitation on the first POD, which was consistent with some of our hypothesis. PNB was a preventive factor for the infeasibility of walking rehabilitation on the first POD. In contrast, the presence of daily oral steroids and the number of DMARDs used, which may be associated with the severity of RA, were not related to postoperative rehabilitation. Our study population all suffered from severe RA and all reported a positive surgical intervention. In addition, the study population maintained general functional ability postoperatively. As our institute is one of the largest national scale rheumatoid centers, anti-rheumatoid medication therapy was well optimized, and there was small difference in the severity of disease among the patients.

Early postoperative rehabilitation is affected by PONV(6),and the incidence of PONV varies from 20–80% (7, 8) and is affected by surgical time, sex, and postoperative opioid (9). As the proportion of woman is quite high in rheumatoid patients, they are expected to be at high risk for PONV. In our study population, the ratio of woman was 96% and among them 29.7% developed PONV. Although IVPCA with fentanyl would provide good management for postoperative pain, postoperative continuous opioid is the risk factor of PONV (9).

In post hoc analysis, postoperative continuous intravenous fentanyl doubled PONV incidence, the choice of regional anesthesia instead of IVPCA for postoperative pain management helps to prevent the incident of PONV.

Multivariate analysis in our study showed association for early rehabilitation and postoperative pain, and it was consistent with the previous report in total knee arthroplasty cases with non-RA patients(10). Generally, postoperative pain control is evaluated by pain score such as Visualized Analogue Scale and Numerical Rating Scale; however the number of pain rescue medications was selected as a factor in our logistic regression model. Because of retrospective study, the timing of pain evaluation may be inconsistent and we considered the number of pain rescue medication to be more precise and objective. Our Kaplan-Meier curves also showed that the time of the first analgesic rescue was associated with early rehabilitation. A longer duration postoperative analgesia and multimodal analgesia is the key to early rehabilitation.

The present study has several limitations. It was a retrospective, single-center study, and patients were not randomized. Choice of anesthesia modality depended on the anesthesiologists in charge, according to the experience of the anesthesiologist. As our institute is an educational institute, regional anesthesia technique might not be performed consistently. The PNB included several types and dosages of local anesthetics. We did not investigate the severity of RA. Instead, we evaluated the grade of severity of RA by the medicines taken by the patients. Further prospective studies are required to evaluate the relationship between anesthesia modality and early rehabilitation in RA patients.

In summary, anesthesia method strongly affects postoperative rehabilitation and postoperative pain management. Continuous epidural anesthesia sometimes results in bilateral motor block, which disturbs early mobilization after surgery and limits early rehabilitation. The choice of PNB instead of IVPCA or epidural anesthesia would have an advantage for early rehabilitation.

Conclusion

The incidence of PONV and inadequate postoperative pain management were predictors for the infeasibility of walking rehabilitation on the first POD. For postoperative rehabilitation after rheumatoid toe surgery, the anesthesia method to prevent PONV and providing good postoperative pain management are important. In addition, adding PNB to GA would decrease PONV and improve postoperative pain management.

Abbreviations

CI
Confidence interval
DMARDs
Disease modifying anti-rheumatic drugs
GA
General anesthesia
IVPCA
intravenous patient controlled analgesia

OR
Odds ratio
PNB
Peripheral nerve block
POD
Postoperative day
PONV
Postoperative nausea and vomiting
RA
Rheumatoid arthritis

Declarations

Ethics approval and consent to participate: Informed consent was waived by the Institutional Review Board of Tokyo Women's Medical University, approval number 4416, July 11, 2017, due to the retrospective nature of the study

Consent for publication: Not applicable

Availability of data and materials: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests: The authors declare they have no competing interests.

Funding: None

Authors' contributions: All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by [SG] and [YK]. The first draft of the manuscript was written by [SG] and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Acknowledgements: Not applicable

References

1. Nguyen-Oghalai TU, Ottenbacher KJ, Caban M, Granger CV, Grecula M, Goodwin JS. The impact of rheumatoid arthritis on rehabilitation outcomes after lower extremity arthroplasty. J Clin Rheumatol . 2007;13:247-50.
2. Ravi B, Escott B, Shah PS, Jenkinson R, Chahal J, Bogoch E, et al. A systematic review and meta-analysis comparing complications following total joint arthroplasty for rheumatoid arthritis versus for osteoarthritis. Arthritis Rheum. 2012;64:3839-49.

3. Singelyn FJ, Deyaert M, Joris D, Pendeville E, Gouverneur JM. Effects of intravenous patient-controlled analgesia with morphine, continuous epidural analgesia, and continuous three-in-one block on postoperative pain and knee rehabilitation after unilateral total knee arthroplasty. Anesth Analg. 1998;87:88-92.
4. Macfarlane AJR, Prasad GA, Chan VWS, Brull R. Does Regional Anesthesia Improve Outcome After Total Knee Arthroplasty? Clin Orthop and Relat Res. 2009;467:2379-402.
5. Goodman SM, Ramsden-Stein DN, Huang WT, Zhu R, Figgie MP, Alexiades MM, et al. Patients with Rheumatoid Arthritis Are More Likely to Have Pain and Poor Function After Total Hip Replacements than Patients with Osteoarthritis. JRheumatol. 2014;41:1774-80.
6. Kehlet H. Multimodal approach to control postoperative pathophysiology and rehabilitation. Br J Anaesth. 1997;78:606-17.
7. Gan TJ, Diemunsch P, Habib AS, Kovac A, Kranke P, Meyer TA, et al. Consensus Guidelines for the Management of Postoperative Nausea and Vomiting. Anesth Analg. 2014;118:85-113.
8. Cao XZ, White PF, Ma H. An update on the management of postoperative nausea and vomiting. J Anesth. 2017;31:617-26.
9. Apfel CC, Heidrich FM, Jukar-Rao S, Jalota L, Hornuss C, Whelan RP, et al. Evidence-based analysis of risk factors for postoperative nausea and vomiting. Br J Anaesth. 2012;109:742-53.
10. Rutherford RW, Jennings JM, Dennis DA. Enhancing Recovery After Total Knee Arthropiasty. Orthop Clin North Am. 2017;48:391-400.

Figures

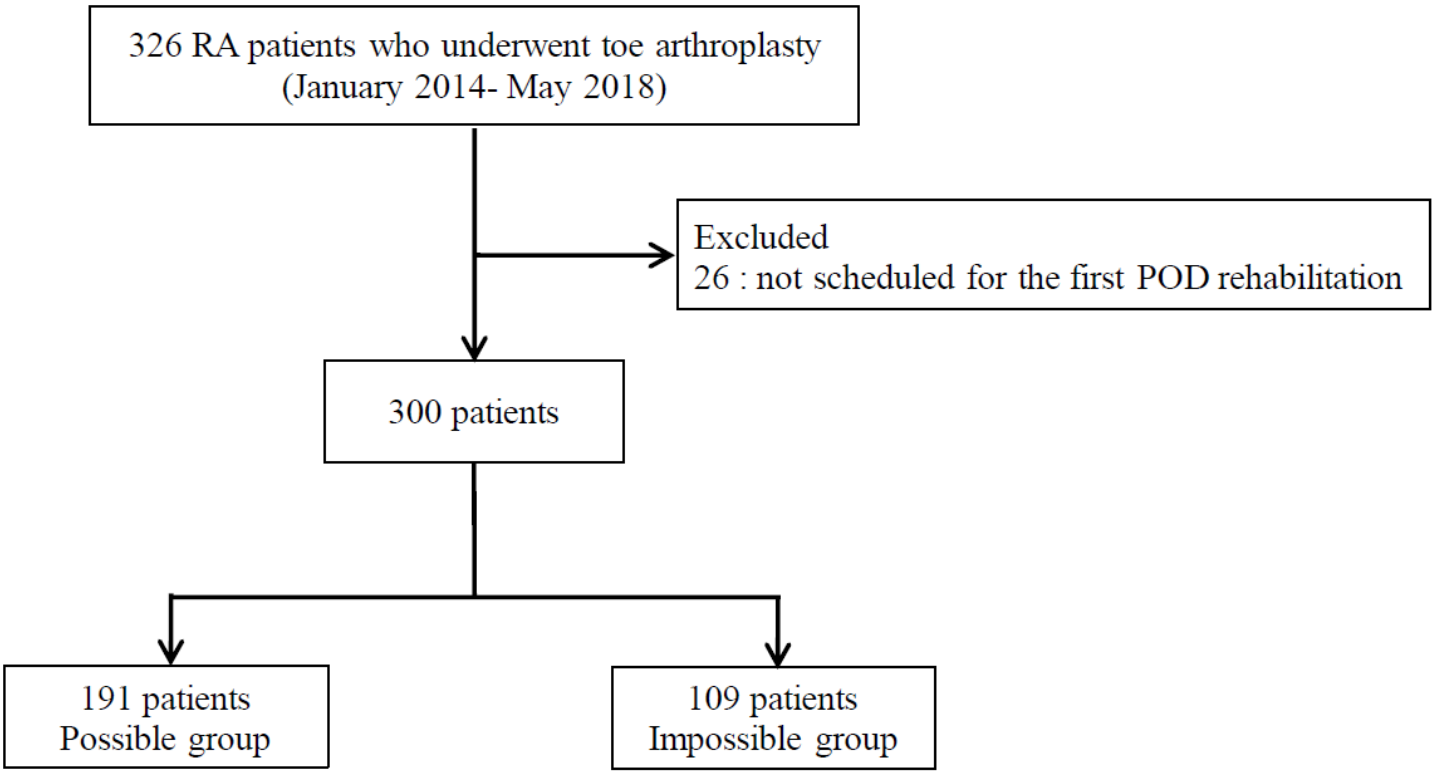

Figure 1

Flow chart of patient selection. RA: rheumatoid arthritis, POD: postoperative day

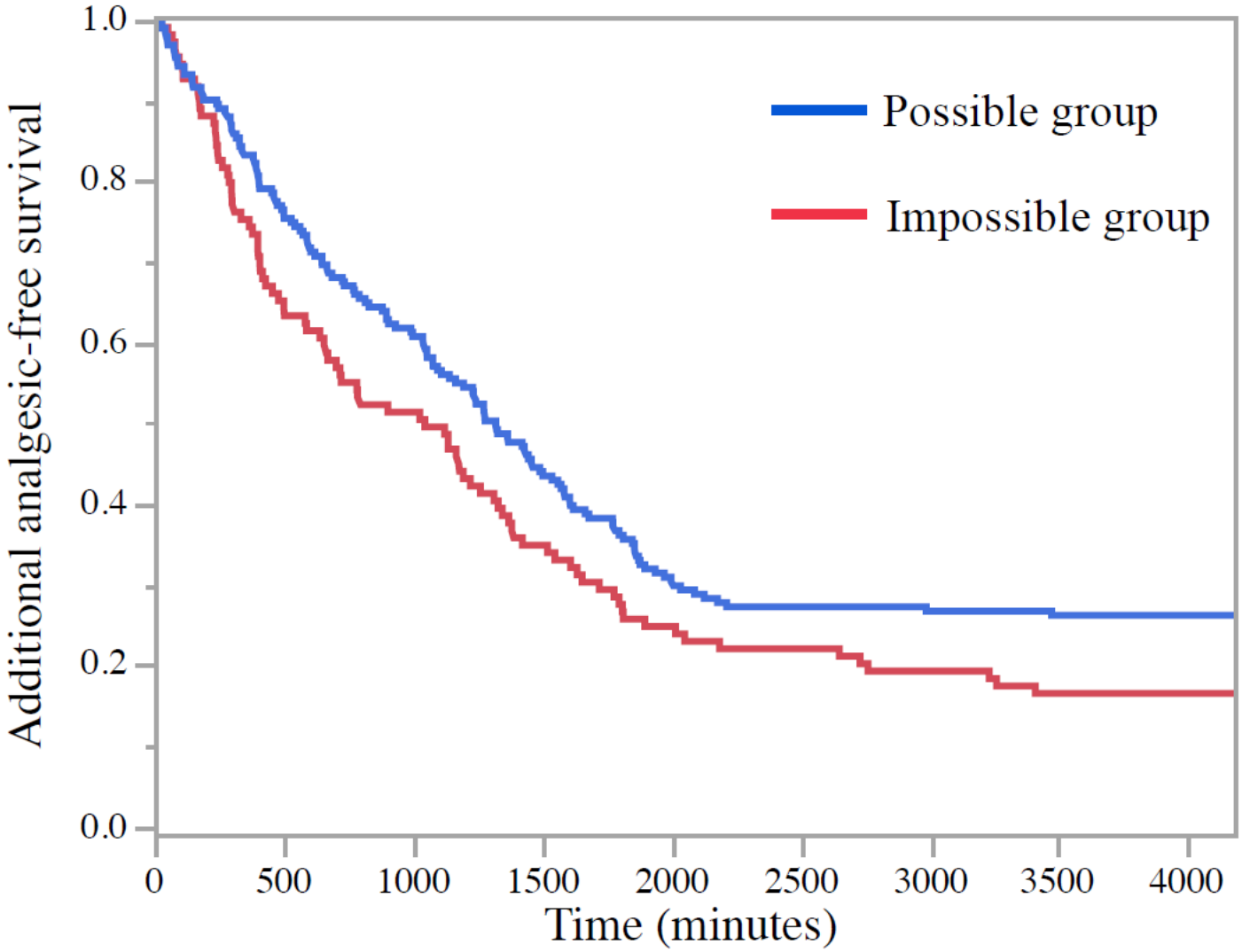

Figure 2

Kaplan-Meier curves for analgesic-free survival after surgery for the two groups under study