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Postoperative Troponin Elevation Predicts 30-Day and 12-Month Mortality in Geriatric Patients Undergoing Hip Fracture Surgery: A 339-Patient Cohort Study

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Abstract

Purpose:

Postoperative myocardial injury after noncardiac surgery (MINS) is a frequent but often silent complication associated with increased mortality. Older adults undergoing hip fracture surgery represent a high-risk trauma population with limited physiological reserve, in whom even small postoperative troponin elevations may reflect clinically meaningful cardiac stress. This study examined the association between postoperative troponin elevation and mortality following surgery for low-energy hip fractures in geriatric patients.

Methods:

We conducted a single-center retrospective cohort study of 339 geriatric patients who underwent operative treatment for proximal femur fractures between June 2017 and January 2020. Demographic data were collected directly from patients at hospital intake and supplemented with information from the national israeli health maintenance organization (HMO) registry. Cardiac troponin I (cTnI) levels were routinely measured within 72 hours postoperatively. MINS was defined as cTnI > 30 ng/dL irrespective of ischemic symptoms. Mortality data (30-day and 12-month all-cause death) were obtained from the HMO. Logistic regression was used to identify independent predictors of mortality.

Results:

MINS occurred in 45.7% (155/339) of patients. MINS-positive patients were older, had a higher comorbidity burden, and more frequently had ischemic heart disease or peripheral vascular disease. Mortality was significantly higher among MINS-positive patients at both 30 days (21.9% vs. 3.8%) and 12 months (48.4% vs. 14.7%) compared with MINS-negative patients (both $p < 0.01$). In multivariable analysis, MINS was the strongest independent predictor of mortality at 30 days (OR 9.03) and 12 months (OR 6.06). Kaplan–Meier curves demonstrated significantly reduced survival in the MINS-positive group.

Conclusions:

Postoperative myocardial injury is associated with increased short- and long-term all-cause mortality, even in the absence of typical ischemic symptoms. Routine postoperative troponin measurement may help identify high-risk orthopedic trauma patients who could benefit from closer monitoring and optimized postoperative management.

Introduction

Hip fractures are among the most serious injuries affecting older adults and represent a major public health burden worldwide. Their incidence is projected to rise substantially with population aging, with lifetime risks estimated at 16–18% in women and 5–6% in men (1, 2). Despite advances in orthogeriatric co-management (3, 4), 12-month mortality remains high—commonly approaching 30% (5–8). Older adults presenting with hip fractures typically have substantial frailty and multimorbidity, including cardiovascular disease, which itself increases both fall risk and postoperative mortality (9–12). Comorbidity burden is often quantified using indices such as the Charlson Comorbidity Index (13).

Myocardial injury after noncardiac surgery (MINS) has emerged as a major postoperative complication associated with excess morbidity and mortality. MINS is defined by postoperative cardiac troponin (cTn) elevation exceeding the 99th percentile upper reference limit (14), and its prognostic importance has been repeatedly demonstrated. Large prospective cohorts and meta-analyses have confirmed that postoperative troponin elevation—frequently asymptomatic—is independently associated with 30-day and long-term mortality (15–21). A pooled MINS incidence of approximately 18% has been reported across noncardiac surgeries (17–19), with higher rates among patients with advanced age, cardiovascular disease, anemia, renal dysfunction, or other chronic conditions (22–27).

Orthopedic trauma patients, and hip fracture patients in particular, appear uniquely vulnerable. Analysis of VISION cohort data demonstrated that 11.9% of orthopedic patients experienced MINS, with 80% lacking typical ischemic symptoms (28). Supplemental data published by Thomas et al. suggests trauma-related orthopedic surgery carries a considerably higher risk of MINS compared to elective procedures, likely due to the urgent nature of surgery, potential hemodynamic instability, anemia, and limited physiological reserve. Elevated troponin on admission following trauma has also been linked to delayed surgery and increased early mortality among hip fracture patients (29). These findings suggest that even minor postoperative troponin elevations in frail geriatric trauma patients may reflect clinically meaningful myocardial stress.

Although MINS is widely recognized in anesthesia and perioperative medicine, routine postoperative troponin measurement has not been adopted universally in orthopedic trauma care. Early identification of myocardial injury could facilitate postoperative monitoring, targeted medical optimization, and potentially the use of therapies shown to improve outcomes in selected MINS patients (30). However, data specifically focused on geriatric hip fracture populations remain limited.

In this retrospective cohort study, we examined postoperative troponin elevation among elderly patients undergoing surgery for low-energy hip fractures. Demographic and comorbidity data were collected directly from patients and/or caregivers at hospital intake and supplemented with information from the national health maintenance organization registry. Robust mortality data at 30 days and 12 months were also obtained from the same registry. Our objectives were to (1) determine the prevalence of MINS in this high-risk population, (2) identify patient factors associated with MINS, and (3) evaluate the association between postoperative troponin elevation and short- and long-term mortality.

Study Design and Setting

We conducted a single-center retrospective cohort study at a level II trauma hospital. The study included all consecutive patients aged ≥65 years who were admitted with a radiographically confirmed proximal femur fracture (femoral neck, intertrochanteric, or subtrochanteric) resulting from low-energy trauma and underwent operative treatment with either open reduction and internal fixation (ORIF) or hemiarthroplasty, between June 2017 and January 2019. Exclusion criteria included refusal or contraindication to surgery, missing or incomplete clinical records or absence of any postoperative troponin measurement.

Data Collection

Clinical data were collected directly from patients or their caregivers at hospital intake, and included demographic data, comorbidities, and baseline medical history. These data were supplemented and cross-validated using the National Health Maintenance Organization (HMO) registry, which also provided robust mortality information for all patients, ensuring complete follow-up for 30-day and 12-month outcomes.

The following comorbidities were recorded based on established definitions: ischemic heart disease (IHD), peripheral vascular disease (PVD), congestive heart failure (CHF), prior cerebrovascular accident (CVA) or transient ischemic attack (TIA), chronic kidney disease (CKD), anemia, chronic obstructive pulmonary disease (COPD), dementia, diabetes mellitus (DM), liver disease, and hypertension. A comorbidity burden score was calculated as the total count of these conditions for each patient.

Troponin Measurement and Definition of MINS

Postoperative cardiac troponin I (cTnI) was measured using the Beckman Coulter Access AccuTnI + 3 (fourth-generation) assay. At our institution, clinical practice during the study period included routine postoperative cTnI sampling at least once within 72 hours after surgery.

Myocardial injury after non-cardiac surgery (MINS) was defined as any cTnI concentration > 30 ng/dL within 72 postoperative hours, irrespective of symptoms or electrocardiographic findings, consistent with previously published thresholds.

Time-to-death and mortality status were obtained from the national HMO registry, which provides complete and continuously updated mortality data for all insured individuals nationwide.

Statistical Analysis

All analyses were performed using SPSS version 22.0 (IBM Corp., Armonk, NY, USA). Continuous variables were assessed for normality using the Shapiro–Wilk test and are reported as mean ± standard deviation. Categorical variables are presented as frequencies and percentages. Group differences

between MINS-positive and MINS-negative patients were evaluated using the independent-samples t-test for continuous variables and the chi-square test for categorical variables.

Regression Models

Binary logistic regression was used to evaluate independent predictors of 30-day and 12-month mortality. Candidate variables included: age, sex, comorbidity burden, individual cardiovascular comorbidities, type of surgical procedure (ORIF vs. hemiarthroplasty), and presence or absence of MINS.

To reduce multicollinearity (correlation between predictor variables or independent variables, such that they express a linear relationship in a regression model), Pearson and Spearman correlation coefficients were examined a priori. Significant collinearity was observed among MINS, ischemic heart disease, and congestive heart failure, as well as between comorbidity burden and age/sex. Therefore, four separate multivariable regression models were constructed for each outcome (30 day and 12 month mortality) to ensure the stability and interpretability of effect estimates. Odds ratios (ORs) with 95% confidence intervals (CIs) are reported. Statistical significance was defined as $p < 0.05$.

Survival Analysis

Time-to-death was analyzed using Kaplan–Meier survival curves, and differences between MINS-positive and MINS-negative groups were evaluated using the log-rank test. Patients alive at last follow-up were treated as censored observations

Results

339 patients met the study inclusion criteria. The average age at time of surgery was 83.8 years. The patient group included 217 females (64%) and 122 males (36%). Preoperative comorbid conditions were frequently reported, including Hypertension (22%), Anemia (25.4%), CKD (16.5%), DM (15%), Liver disease (2.7%),COPD (6.8%), Dementia (15.3%), History of CVA or TIA (9.1%), PVD (6.2%), CHF (12.1%) and IHD (17.4%). Overall, the average number of comorbid conditions was 1.5 per patient. (See Table 1).

Surgical intervention was decided upon based on patient characteristics and the fracture pattern: 72.6% of patients underwent an open reduction with internal fixation (ORIF) of the femoral neck using a Cephalomedullary nail (CMN) or a dynamic hip screw construct (DHS). An additional 4.7% of patients underwent ORIF using CMN stabilization of the proximal femur distal to the femoral neck at the level of the femoral shaft. The remaining 22.7% of the cohort underwent a hemiarthroplasty using a bipolar endoprosthesis.

MINS levels, measured within 72 hours of surgery, were found positive in 155 (45.7%) patients. Mean Troponin values for MINS negative patients was 15.0 ng/dl, with a mean troponin value of 79.8 ng/dl for MINS positive patients. Patients with positive MINS had an average age of 84.9 at the time of operation

compared to their MINS negative counterparts, who were 82.8 (P = 0.027). Patients diagnosed with MINS had a higher comorbidity burden, presenting with 1.7 comorbid conditions compared to 1.2 for their MINS negative counterparts (P < 0.001). MINS positive patients were more likely to have reported preexisting ischemic heart disease (IHD) and peripheral vascular disease (PVD). Other comorbid conditions included in the study, i.e COPD, Dementia, CVA, CHF, Anemia, HTN, CKD, DM or liver diseases were not significantly associated with MINS occurrence.

Table 1
descriptive analysis of the cohort depending on MINS positivity

Female sex	**Positive MINS**	**Negative MINS**	**Significance (P Value)**
	91 (58.7%)	**126 (68.5%)**	**0.062**
Comorbid conditions (n)	1.7	1.2	< 0.001
Age (years)	84.9	82.8	0.027
COPD (%)	5.8%	7.6%	0.511
Dementia	17.4%	13.6%	0.329
History of CVA/TIA	9.0%	9.2%	0.948
PVD	9.0%	3.8%	0.048
CHF	15.5%	9.2%	0.079
IHD	28.4%	8.2%	< 0.001
Anemia	29.7%	21.7%	0.09
HTN	23.9%	21.7%	0.64
CKD	20.6%	13.0%	0.06
DM	15.5%	14.7%	0.835
Liver Disease	2.6%	2.7%	0.938

The mortality rates within the general cohorts were high, with overall rates of 12.1% and 30.1% within 30 days and 1 year of surgical intervention respectively. Rates of mortality within 30 days and 12 months among patients diagnosed with MINS were 21% and 48.4% respectively (Table 2). A Kaplan Meier Analysis and Log rank Test were performed to investigate the cumulative effect on death rates between MINS positive and MINS negative patients until the end of follow up (Graph 1). About 45% of our patients did not experience the event (death) by the end of the follow-up. These data were categorized as censored data. The difference in death rates between the two groups was highly statistically significant (P < 0.05).

Table 2
Effect of MINS status on mortality at 30 days and 12 months

Mortality at 30 days	**MINS positive (155)**	**MINS negative (184)**	**P Value (Z test for difference in Ratios)**
	34 (21.9%)	**7 (3.8%)**	**P < 0.01**
Mortality at 12 Months	75 (48.4%)	27 (14.7%)	P < 0.01

Graph 1: Kaplan Meier plot detailing survival rates in MINS positive vs. MINS negative patients

A multiple regression analysis was performed to detect the independent variables predicting long and short-term mortality (Table 3,4). The model showed a strong association between MINS positivity and both 12 months and 30-day mortality, with an odds ratio (OR) of 6.1 (P < 0.001, CI 3.4–10.5) and 9.03 (P < 0.001, CI 3.6–22.7) respectively. Age was also independently associated with increased mortality rates within 30 days (P < 0.05, CI 1.01–1.11) and 1 year (P < 0.001, CI 1.01–1.08). Female sex was associated with decreased mortality rates within 30 days (P < 0.05, CI 0.24–0.93) but had no significant association with mortality at 1 year (Table 4). The remaining multiple regression models showed no further statistically significant independent variables associated with mortality. The multiple regression models completed to avoid collinearity are saved to our registry and will be made available as supplement material upon request.

Table 3
Factors associated with mortality at 30 days

Independent Variable	Odds ratio	P Value	95% Confidence interval
CHF	0.21	0.06	0.047–1.06
PVD	0.57	0.49	0.12–2.77
History of CVA / TIA	0.81	0.76	0.21–3.17
Dementia	1.64	0.32	0.61–4.4
COPD	3.54	0.08	0.87–14.4
T2 Diabetes	0.39	0.19	0.09–1.58
CKD	1.47	0.46	0.53–4.1
Anemia	0.64	0.31	0.26–1.53
HTN	0.225	0.015	0.06–0.74
IHD	1.76	0.18	0.76–4.02
Positive MINS	9.03	< 0.001	3.66–22.27
Number of comorbid conditions	0.98	0.91	0.77–1.25
Female sex	0.47	0.03	0.24–0.93
Age	1.06	0.02	1.01–1.11
Type of procedure: ORIF	1.4	0.4	0.62–3.31

Table 4
Factors associated with mortality at 12 months

Independent Variable	Odds ratio (OR)	P Value	95% Confidence interval
CHF	1.13	0.75	0.52–2.47
PVD	0.94	0.92	0.32–2.81
History of CVA / TIA	1.2	0.69	0.49–2.92
Dementia	1.05	0.37	0.71–2.98
COPD	2.42	0.09	0.85–16.49
T2 Diabetes	0.66	0.31	0.30–1.46
CKD	1.24	0.56	0.60–2.55
Anemia	0.78	0.42	0.42–1.44
HTN	0.66	0.15	0.31–1.12
IHD	1.45	0.24	0.78–2.70
Positive MINS	6.06	< 0.001	3.47–10.57
Number of comorbid conditions	1.2	0.10	0.97–1.36
Female sex	1.01	0.97	0.61–1.69
Age	1.05	0.005	1.01–1.08
Type of procedure: ORIF	0.59	0.06	0.34–1.02

Discussion

Our study demonstrates that postoperative troponin elevation is common among geriatric hip fracture patients and is a powerful predictor of both short- and long-term mortality. Nearly half of our cohort experienced myocardial injury after surgery, most of which was clinically silent. Importantly, MINS was the strongest independent predictor of 30-day and 12-month mortality, even after adjusting for age, comorbidities, and surgical factors.

These findings underscore the particular vulnerability of older trauma patients. Unlike elective surgical populations, geriatric patients with hip fractures present with a combination of frailty, multimorbidity, and acute physiological stress from trauma. Even minor troponin elevations in this group likely reflect clinically meaningful myocardial injury rather than incidental findings. This contrasts with younger or elective cohorts, in whom small troponin elevations may carry less prognostic weight (31).

Previous studies have established the prognostic value of MINS in noncardiac surgery, but data focusing specifically on elderly trauma patients are limited. Our results align with prior observations from large

surgical cohorts but expand the evidence by demonstrating the high prevalence and strong prognostic relevance of MINS in a population at particular risk for poor outcomes (10–12). The high incidence of silent myocardial injury, also evident in the work by Thomas et al (28), emphasizes that clinical monitoring alone is insufficient, and that routine postoperative troponin measurement could provide critical information for early risk stratification.

From a clinical perspective, identifying MINS-positive patients may inform postoperative management. These patients could benefit from closer monitoring, cardiology evaluation, optimization of fluid and hemodynamic status, and consideration of targeted therapies such as beta-blockers or antiplatelet therapy where appropriate (32). While our study does not test interventions, it highlights the need for prospective trials to determine whether early detection and management of postoperative myocardial injury can improve outcomes in this high-risk group.

Limitations of this study include its retrospective design, single-center setting, and the lack of universal preoperative troponin measurement, which could lead to underestimation of preexisting myocardial injury. Additionally, the timing of postoperative troponin measurement was not strictly standardized beyond measurement within 72 hours. Despite these limitations, the study benefits from a well-characterized cohort, complete follow-up through a national registry, and detailed comorbidity data.

Conclusions

Postoperative myocardial injury is frequent among geriatric hip fracture patients and strongly predicts both short- and long-term mortality. This study highlights that older trauma patients represent a uniquely vulnerable subgroup in whom even modest troponin elevations carry substantial prognostic significance. Routine postoperative troponin measurement in this population may facilitate early identification of high-risk patients and guide postoperative monitoring and management strategies. Future research should focus on interventions to mitigate risk and improve survival in MINS-positive elderly trauma patients.

Declarations

Conflict of interest

The authors disclose no conflicts of interest.

Ethics Declarations

This study was conducted in accordance with the 1964 Declaration of Helsinki and its later amendments, and the protocol was approved by the Kaplan Medical Center (KMC) Ethics Committee under approval number KMC014520. Informed consent was obtained from all individual participants (or their legally authorized representatives) prior to enrollment.

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Author Contribution

1. Tomer Keidan, MD-MPH - Conceptualization, manuscript preperation, analysis2. Amster-Kahn, Hagay, MD- conceptualization, statistical analysis, manuscript revision3. Kai Rosen, MD - manuscript revision, statistical analysis, graph preperation4. Nina Ramroth-Stich, MD - manuscript review, editing5. Emre Yilmaz, MD - manuscript review, editing, analysis6. Matthias Königshausen, MD -manuscript review, editing, analysis7. Spieckermann, Aileen, MD - manuscript review, editing, analysis8. Thomas A. Schildhauer, MD-PHD -manuscript review, editing, analysis9. Christos Koutras, MD - manuscript review, editing, statistical analysis, conceptualization

References

1. Kannus P, Parkkari J, Sievänen H, Heinonen A, Vuori I, Järvinen M. Epidemiology of hip fractures. Bone. 1996;18(1 Suppl):S57–63.
2. Gullberg B, Johnell O, Kanis JA. World-wide projections for hip fracture. Osteoporos Int. 1997;7(5):407–13.
3. Overview |. Hip fracture: management | Guidance | NICE.; Available from:
4. Ranhoff AH, Saltvedt I, Frihagen F, Raeder J, Maini S, Sletvold O. Interdisciplinary care of hip fractures: Orthogeriatric models, alternative models, interdisciplinary teamwork. Best Pract Res ClinRheumatol. 2019;33(2):205–26.
5. Meyer AC, Ek S, Drefahl S, Ahlbom A, Hedström M, Modig K. Trends in Hip Fracture Incidence, Recurrence, and Survival by Education and Comorbidity: A Swedish Register-based Study. Epidemiology. 2021;32(3):425–33.
6. Goldacre MJ, Roberts SE, Yeates D. Mortality after admission to hospital with fractured neck of femur: database study. BMJ. 2002;325(7369):868–9.
7. Bliuc D, Nguyen ND, Milch VE, Nguyen TV, Eisman JA, Center JR. Mortality risk associated with low-trauma osteoporotic fracture and subsequent fracture in men and women. JAMA. 2009;301(5):513–21.
8. Website. National Hip Fracture Database - National Falls and Fragility Fracture Audit Programme (FFFAP). National Hip Fracture Database.
9. Brauer CA, Coca-Perraillon M, Cutler DM, Rosen AB. Incidence and mortality of hip fractures in the United States. JAMA. 2009;302(14):1573–9.
10. Wong RMY, Zu Y, Chau WW, Tso CY, Liu WH, Ng RWK, et al. High Charlson Comorbidity Index Score is associated with early fracture-related complication for internal fixation of neck of femur fractures.

Sci Rep. 2022;12(1):1–9.

11. Sennerby U, Melhus H, Gedeborg R, Byberg L, Garmo H, Ahlbom A, et al. Cardiovascular diseases and risk of hip fracture. JAMA. 2009;302(15):1666–73.
12. Xu B, Han L, Liu H, Wang J, Bao XY, Xi HX, et al. Cardiovascular disease and hip fracture among older inpatients in Beijing, China. Biomed Res Int. 2013;2013:493696.
13. Charlson ME, Pompei P, Ales KL, MacKenzie. CR. A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. J Chronic Dis 1987Jan1;40(5):373–83.
14. Fernando Botto 1, Pablo, Alonso-Coello MTV, Chan JC, Villar D, Xavier et al. Myocardial Injury after Noncardiac Surgery: A Large, International, Prospective Cohort Study Establishing Diagnostic Criteria, Characteristics, Predictors, and 30-day Outcomes. Anesthesiology. 2014;120(3):564–78.
15. Ruetzler K, Khanna AK, Sessler DI. Myocardial Injury AfterNoncardiac Surgery: Preoperative, Intraoperative, and Postoperative Aspects, Implications, and Directions. AnesthAnalg. 2020;131(1):173–86.
16. Vascular Events In Noncardiac Surgery Patients Cohort Evaluation (VISION) Study Investigators, Devereaux PJ, Chan MTV, Alonso-Coello P, Walsh M, Berwanger O et al. Association between postoperative troponin levels and 30-day mortality among patients undergoing noncardiac surgery. JAMA. 2012;307(21):2295–304.
17. Smilowitz NR, Redel-Traub G, Hausvater A, Armanious A, Nicholson J, Puelacher C et al. Myocardial Injury After Noncardiac Surgery: A Systematic Review and Meta-Analysis. Cardiol Rev 2019 Nov/Dec;27(6):267–73.
18. Writing Committee for the VISION Study Investigators, Devereaux PJ, Biccard BM, Sigamani A, Xavier D, Chan MTV, et al. Association of Postoperative High-Sensitivity Troponin Levels With Myocardial Injury and 30-Day Mortality Among Patients Undergoing Noncardiac Surgery. JAMA. 2017;317(16):1642–51.
19. Puelacher C, LuratiBuse G, Seeberger D, Sazgary L, Marbot S, Lampart A, et al. Perioperative Myocardial Injury After Noncardiac Surgery: Incidence, Mortality, and Characterization. Circulation. 2018;137(12):1221–32.
20. Thygesen K, Alpert JS, Jaffe AS, Chaitman BR, Bax JJ, Morrow DA, et al. Fourth universal definition of myocardial infarction (2018). Eur Heart J. 2019;40(3):237–69.
21. Levy M, Heels-Ansdell D, Hiralal R, Bhandari M, Guyatt G, Yusuf S, et al. Prognostic value of troponin and creatine kinase muscle and brain isoenzyme measurement after noncardiac surgery: a systematic review and meta-analysis. Anesthesiology. 2011;114(4):796–806.
22. Smilowitz NR, Gupta N, Guo Y, Beckman JA, Bangalore S, Berger JS. Trends in cardiovascular risk factor and disease prevalence in patients undergoing non-cardiac surgery. Heart. 2018;104(14):1180–6.
23. Marin JM, Agusti A, Villar I, Forner M, Nieto D, Carrizo SJ, et al. Association between treated and untreated obstructive sleep apnea and risk of hypertension. JAMA. 2012;307(20):2169–76.

24. Chan MTV, Wang CY, Seet E, Tam S, Lai HY, Walker S, et al. Postoperative vascular complications in unrecognised Obstructive Sleep apnoea (POSA) study protocol: an observational cohort study in moderate-to-high risk patients undergoing non-cardiac surgery. BMJ Open. 2014;4(1):e004097.
25. Turan A, Rivas E, Devereaux PJ, Bravo M, Mao G, Cohen B, et al. Association between postoperative haemoglobin concentrations and composite of non-fatal myocardial infarction and all-cause mortality in noncardiac surgical patients: post hoc analysis of the POISE-2 trial. Br J Anaesth. 2021;126(1):87–93.
26. George R, Menon VP, Edathadathil F, Balachandran S, Moni M, Sathyapalan D, et al. Myocardial injury after noncardiac surgery-incidence and predictors from a prospective observational cohort study at an Indian tertiary care centre. Med (Baltim). 2018;97(19):e0402.
27. Ackland GL, Abbott TEF, Cain D, Edwards MR, Sultan P, Karmali SN, et al. Preoperative systemic inflammation and perioperative myocardial injury: prospective observational multicentre cohort study of patients undergoing non-cardiac surgery. Br J Anaesth. 2019;122(2):180–7.
28. Thomas S, Borges F, Bhandari M, De Beer J, UrrútiaCuchí G, Adili A, et al. Association Between Myocardial Injury and Cardiovascular Outcomes of Orthopaedic Surgery: A Vascular Events in Noncardiac Surgery Patients Cohort Evaluation (VISION) Substudy. J Bone Joint Surg Am. 2020;102(10):880–8.
29. O'Hara NN, Wu J, Rolle N, Sprague S, Devereaux PJ, Borges FK, et al. Hip Fracture With Elevated Troponin: Harbinger of Mortality or Need for Accelerated Surgery? J Orthop Trauma. 2022;36(12):604–9.
30. Devereaux PJ, Duceppe E, Guyatt G. Dabigatran in patients with myocardial injury after non-cardiac surgery (MANAGE): an international, randomised, placebo-controlled trial. Lancet. 2018;391(10137):2325–34.
31. Bass AR, Levin LF. Should All Orthopaedic Patients Undergo Postoperative Troponin Testing? Commentary on an article by Sabu Thomas, MD, MSc et al. Association Between Myocardial Injury and Cardiovascular Outcomes of Orthopaedic Surgery. A Vascular Events in Noncardiac Surgery Patients Cohort Evaluation (VISION) Substudy. J Bone Joint Surg Am. 2020;102(10):e46.
32. Baroni M, Serra R, Boccardi V, Ercolani S, Zengarini E, Casucci P, et al. The orthogeriatriccomanagement improves clinical outcomes of hip fracture in older adults. Osteoporos Int. 2019;30(4):907–16.

Figures

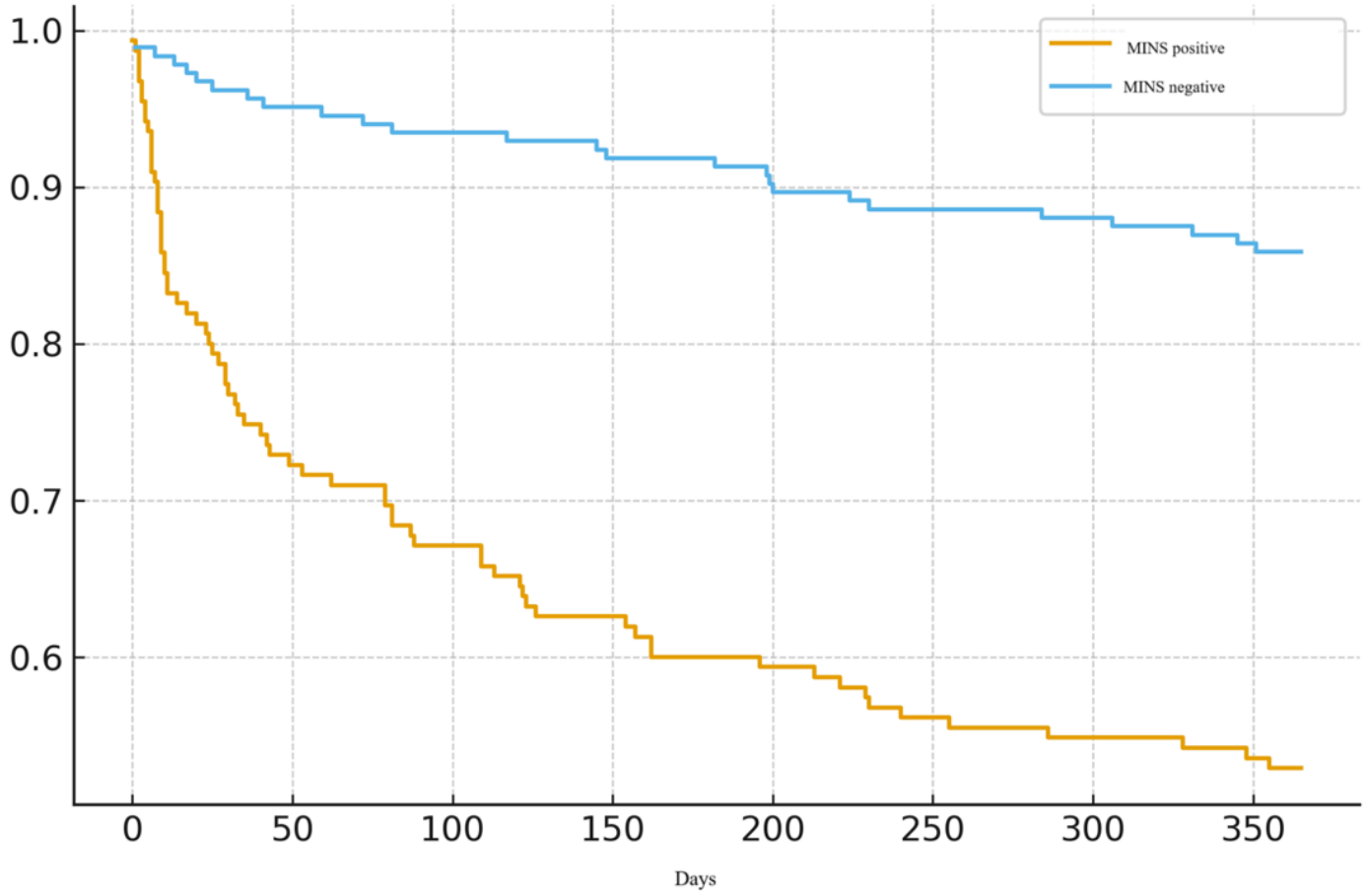


Figure 1

Graph 1: Kaplan Meier plot detailing survival rates in MINS positive vs. MINS negative patients