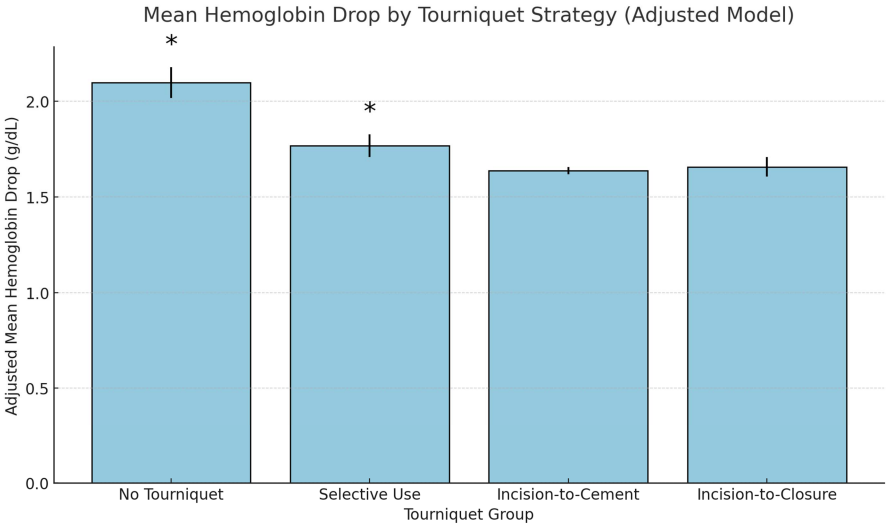
Finding the Sweet Spot: Comparative Outcomes of Four Tourniquet Strategies in 15,000 Total Knee Arthroplasties

Katherine E Mallett, Aaron Ira Weinblatt, Ranqing Lan, Nathaniel T Ondeck, Felix Conrad Oettl, Stephen Lyman, Brian Chalmers, Alejandro Gonzalez Della Valle

INTRODUCTION:
While tourniquets are commonly used in total knee arthroplasty (TKA), their impact on perioperative blood loss remains debated. Tourniquet use may improve surgical field visibility and reduce intraoperative blood loss; however, some studies suggest avoiding tourniquets may reduce total blood loss by limiting reactive hyperemia. Given the lack of consensus on tourniquet use, this study compared the effects of four distinct tourniquet strategies on perioperative blood loss in a large, single-institution cohort.
METHODS:
Following institutional review board approval, we retrospectively reviewed 15,394 primary TKA for osteoarthritis from 2019-2023 at a high-volume academic center. We excluded patients under 45 years and TKA with hardware removal. Tourniquet use was categorized into four groups: no tourniquet (7%), selective tourniquet for cementation only (16%), tourniquet from incision through cementation (56%), and tourniquet from incision through skin closure (21%). Outcome variables included perioperative change in hemoglobin, calculated blood loss (CBL) using Nadler and Mercuriali's equations, rate of blood transfusion, and length of stay.
The hemoglobin drop by tourniquet use was compared by one-way ANOVA test, and the transfusion rate was compared by the Chi-squared test. Mixed-effects linear regression was used to evaluate the association between hemoglobin drop and tourniquet use, while mixed-effects logistic regression was used to assess the association between blood transfusion and tourniquet use. Both models included the surgeon as a random intercept and were adjusted for potential confounders.
RESULTS:
The mean decrease in hemoglobin drop was 1.64 g/dL in the reference incision-to-cementation group, 1.86 g/dL in the no tourniquet group, 1.64 g/dL in the selective tourniquet group, and 1.72g/dL in the incision-to-closure group. In the adjusted mixed-effects linear model, compared to the incision-to-cementation group, the no tourniquet group experienced a significantly greater drop in hemoglobin (+0.46g/dL; 95% CI: 0.38-0.54, $p<0.001$), and selective tourniquet use was also associated with a smaller but significantly greater hemoglobin drop (+0.13g/dL; 95% CI: 0.07-0.19, $p<0.001$). Incision-to-closure use did not differ from incision-to-cementation in hemoglobin drop (+0.02 g/dL; 95% CI: -0.03-0.07, $p=0.446$). Median CBL was highest with no tourniquet (790mL), followed by incision-to-closure (730mL), incision-to-cementation (730mL), and selective use (680mL) ($p<0.001$).
In the univariate analysis, blood transfusion rates did not differ significantly by tourniquet group (no tourniquet 2.3%, selective 1.5%, incision-to-cementation 1.9%, and incision-to-closure 1.6%). In the adjusted mixed-effects logistic model, the no tourniquet group had over twice the odds of postoperative transfusion compared to incision-to-cementation (OR=2.51; 95% CI: 1.45-4.37, $p=0.001$). Selective tourniquet use and tourniquet use from incision-to-closure did not significantly differ from the incision-to-cementation group (OR=0.98; 95% CI: 0.58-1.65, $p=0.947$ and OR=0.68; 95% CI 0.45-1.03, $p=0.071$, respectively).
DISCUSSION AND CONCLUSION:
This study is the largest contemporary single-institution analysis comparing the four most common tourniquet use patterns in TKA. Forgoing a tourniquet was associated with a significantly greater drop in hemoglobin, CBL, and an over 2x greater risk of postoperative transfusion. Selective use was also associated with a significant decrease in hemoglobin, but not an increased risk of transfusion. Tourniquet use from incision-to-cementation resulted in the smallest drop in hemoglobin and the lowest risk of transfusion. These findings support a tailored approach to tourniquet use, with tourniquet use from incision to cementation or selective use offering a favorable balance between blood conservation and clinical outcomes.


Mean Hemoglobin Drop by Tourniquet Strategy (Adjusted Model)
Adjusted Mean Hemoglobin Drop (g/dL)
0.0
0.5
1.0
1.5
2.0
*
*
No Tourniquet
Selective Use
Incision-to-Cement
Incision-to-Closure
Tourniquet Group