

# Effects of Stepwise versus Conventional Tourniquet Deflation on Systemic Changes in Total Knee Arthroplasty

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## INTRODUCTION:

The pneumatic air tourniquet is widely used in total knee arthroplasty (TKA) to minimize intraoperative blood loss, provide a clear operative field, and enhance cement fixation. Nevertheless, its use may develop postoperative thigh pain, muscle and nerve damage, and systemic complications, such as ischemia–reperfusion injury, leading to electrolyte disturbances and cardiac arrest. Compared with the conventional deflation, we hypothesized that the stepwise deflation could reduce systemic invasion and the variations in vital signs and laboratory data following tourniquet use. This study aimed to evaluate whether the stepwise deflation could decrease systemic complications compared with the conventional deflation.

## METHODS:

Primary TKA cases at our institution from December 2023 to July 2025 were included in this study. A pneumatic tourniquet was inflated to 280 mmHg before the skin incision and released after cement fixation of the implants. In the conventional group, the tourniquet was released at once, whereas in the step group, the air pressure was decreased by 50 mmHg every 5 seconds. Vital signs, including body temperature (BT) and arterial blood pressure (BP), and respiratory data, including oxygen partial pressure (PaO<sub>2</sub>) and end-tidal carbon dioxide partial pressure (etCO<sub>2</sub>), were measured. Blood examinations were performed before and 5, 10, and 30 minutes after tourniquet release, including complete blood count, serum chemistry, lactic acid, and D-dimer levels. Statistical analysis was performed using one-way analysis of variance, with the significance level set at 0.05. This study was approved by the institutional review board.

## RESULTS:

A total of 41 patients (8 men and 33 women) underwent TKA, and subsequently, the step group included 59 patients (7 men and 52 women). There were no critical complications related to tourniquet use in all cases. In both groups, BP decreased immediately after the deflation, and BP continued for approximately 15 minutes. Creatine kinase, D-dimer, and lactate levels increased after the deflation, and these changes persisted for 30 minutes; however, there was no significant difference between the two groups. The etCO<sub>2</sub> also increased in both groups, but the increase level was slightly lower in the step group at 5 minutes after deflation ( $p < 0.05$ ).

## DISCUSSION:

Systemic influences, including changes in vital signs and laboratory data, were observed after tourniquet release in TKA. Although no major perioperative complications were detected in our cases, these findings may affect older patients with cardiac or respiratory comorbidities. As we observed a beneficial effect only in the etCO<sub>2</sub> level, we plan to develop a modified step deflation protocol. The limitation of this study was the small sample size, and we intend to continue the study to increase the number of patients.

## SIGNIFICANCE/CLINICAL RELEVANCE:

Tourniquet deflation affects vital signs and laboratory data. A step deflation protocol may diminish the increase in etCO<sub>2</sub>.

## IMAGES and TABLES

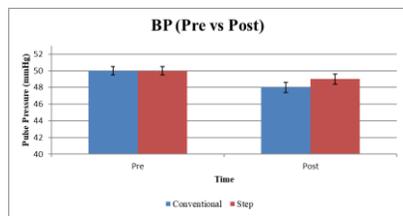


Fig.1

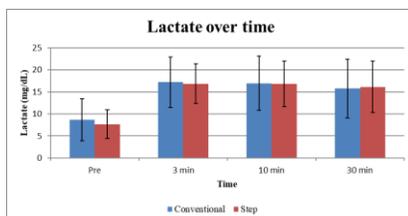


Fig. 2

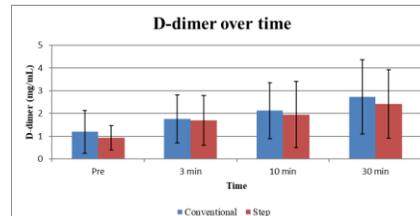


Fig. 3

Fig. 1: Pulse Pressure (mmHg). Both groups showed a transient decrease after tourniquet release, with no significant difference between groups.

Fig. 2: Lactate (mg/dL). Lactate increased immediately at 5 minutes after release and subsequently declined in both groups.

Fig. 3: D-dimer (mg/mL). D-dimer levels gradually increased up to 30 minutes, without intergroup differences.