

EVALUATION AND ENHANCEMENT OF ADHERENCE TO TRANEXAMIC ACID IN TOTAL KNEE REPLACEMENTS BASED ON NICE GUIDELINES.

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ABSTRACT

Background: Tranexamic acid (TXA) is widely recognized for its role in minimizing perioperative blood loss, particularly in orthopedic procedures such as total knee arthroplasty (TKA). Its efficacy in reducing the need for transfusions and improving patient outcomes has been well documented. International guidelines, including those from the National Institute for Health and Care Excellence (NICE), recommend a multimodal approach incorporating intravenous and topical administration for optimal effect. However, adherence to these best practices in real-world clinical settings often remains suboptimal. This Quality Improvement Project (QIP) was conducted at CMH Abbottabad to assess current TXA administration protocols, identify barriers to compliance, and implement targeted interventions to enhance adherence to evidence-based recommendations.

Objective: This study aimed to assess the current practice of tranexamic acid (TXA) administration during total knee arthroplasty (TKA) at CMH Abbottabad and implement a quality improvement initiative to enhance adherence to NICE guidelines. By identifying gaps in compliance and addressing barriers to optimal TXA use, this project sought to standardize practice, improve patient outcomes, and minimize perioperative blood loss more effectively.

Methods: A two-cycle clinical audit was conducted at CMH Abbottabad from August 01 to October 30, 2022, to evaluate adherence to NICE guidelines regarding tranexamic acid (TXA) use in total knee arthroplasty (TKA). A total of 93 TKA cases were retrospectively analyzed to assess compliance. Between the two cycles, targeted educational interventions were introduced, including interactive presentations, email reminders, and strategically placed instructional posters within the orthopedic department. Data were extracted from operative notes, and statistical analysis was performed to measure the impact of these interventions on improving compliance rates.

Results: The first audit cycle at CMH Abbottabad revealed a 51.2% non-compliance rate with NICE guidelines for tranexamic acid (TXA) use in total knee arthroplasty (TKA). Following the targeted educational interventions, compliance significantly improved, with TXA utilization increasing from 48.8% to 73.1% ($p = 0.016$). As per guidelines, the adoption of combined topical and intravenous administration improved markedly from 7.3% to 30.8% ($p = 0.005$). Further subgroup analysis of the second audit cycle indicated higher compliance in non-tourniquet cases and better adherence to TXA use in patients with renal impairment, highlighting the effectiveness of focused interventions in optimizing perioperative blood conservation strategies.

Conclusion: Implementing targeted educational interventions significantly improved adherence to NICE guidelines for TXA use in TKA at CMH Abbottabad. This highlights the importance of structured training sessions and reinforcement strategies in optimizing perioperative blood management. Integrating TXA administration into preoperative surgical checklists and conducting regular educational sessions—particularly addressing its safety profile in patients with renal impairment—could enhance compliance further. Sustained efforts in awareness, protocol standardization, and multidisciplinary collaboration will be crucial for ensuring long-term adherence.

Keywords: NICE guidelines, quality improvement, re-audit, total knee arthroplasty (TKA), tranexamic acid (TXA), surgical blood management, perioperative care

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INTRODUCTION:

In response to tissue injury, fibrinolysis and the coagulation cascade are simultaneously activated. The coagulation cascade leads to fibrin formation, while fibrinolysis counteracts this process by degrading fibrin to maintain hemostatic balance. Tranexamic acid (TXA), first synthesized in 1957, is an antifibrinolytic agent that competitively inhibits the conversion of plasminogen to plasmin, thereby preventing fibrin degradation. Additionally, TXA inhibits plasmin-induced platelet activation, preserving platelet function for clot formation. Beyond its hemostatic role, TXA also exhibits anti-inflammatory properties by suppressing plasmin-mediated inflammatory responses. Given these advantages, TXA has been widely used in orthopedics procedures, including total knee arthroplasty (TKA), significantly reducing perioperative blood loss and the need for transfusions¹. The National Institute for Health and Care Excellence (NICE) recommends a combined intravenous and topical approach for TXA administration in patients without renal impairment, as this dual-route strategy effectively addresses systemic and local bleeding risks². Despite these established guidelines, adherence to TXA protocols remains inconsistent in many clinical settings. This quality improvement project (QIP) was undertaken at CMH Abbottabad to evaluate compliance with TXA administration guidelines during TKAs and implement targeted interventions to optimize adherence. A two-cycle audit was conducted to assess current practices and measure the impact of educational initiatives on improving compliance with evidence-based TXA use.

MATERIALS AND METHODS:

This quality improvement project was conducted as a two-cycle audit within the Trauma and Orthopedics Department of CMH Abbottabad, a key surgical center known for elective hip and knee surgeries. The primary objective of this initiative was to evaluate and enhance adherence to the National Institute for our department. A total of 93 TKA cases were included in the audit, comprising 41 cases from the first cycle and 52 from the second. A retrospective analysis of operation notes was conducted to compare the TXA administration practices before and after implementing an educational intervention. This intervention aimed to address barriers to compliance with the NICE guidelines and improve the overall management of blood loss during TKA procedures. By evaluating pre- and post-intervention data, we assessed the impact of educational efforts on adherence to the recommended TXA administration protocol.

Audit Cycles: In the first audit cycle, a retrospective review was conducted on the electronic records of 41

Total Knee Arthroplasty (TKA) cases were performed between August 01, 2022, and September 15, 2022. The findings from this initial cycle were thoroughly analyzed, and an educational intervention was designed to address barriers to compliance with the recommended use of Tranexamic Acid (TXA) during TKAs. This intervention involved a series of departmental initiatives, including targeted emails to consultants and registrars, alongside a presentation of the audit results at a specialty meeting. Additionally, informative posters highlighting the TXA administration protocol and the NICE guidelines were placed on computers throughout the elective surgical suite and doctors' workstations to ensure continuous visibility. Following these educational efforts, the second audit cycle was conducted, reviewing TKA cases performed from September 20, 2022, to October 30, 2022.

Outcome Measures: The primary outcome measures included the percentage of cases where Tranexamic Acid (TXA) was not administered, as well as the specific routes of TXA administration (intravenous, topical, or both). Secondary outcome measures evaluated how renal impairment and tourniquet use influenced adherence to the TXA administration guidelines. A two-proportion Z-test was employed for statistical analysis to assess the significance of differences in compliance rates between the two audit cycles. Additionally, descriptive subgroup analyses were conducted to examine the effect of renal impairment and tourniquet use on TXA guideline adherence.

RESULTS: In the first audit cycle, out of 41 total knee arthroplasty (TKA) cases, Tranexamic Acid (TXA) was not administered in 21 (51%) cases. Following educational interventions, adherence to TXA administration improved significantly in the second cycle, with TXA not being administered in only 14 (27%) cases. Correspondingly, TXA was used in 20 (48.8%) first-cycle cases, which increased to 38 (73.1%) in the second cycle. A two-proportion Z-test was performed to compare the proportions of TXA use between the two cycles, yielding a p-value of 0.016. This result indicates that the increase in TXA usage from cycle 1 to cycle two was statistically significant, as shown in **Table 1**.

Audit Cycle	TXA Administered	TXA Not Administered	Total Cases	% TXA Administered	% TXA Not Administered
First Cycle	20	21	41	48.8%	51.2%
Second Cycle	38	14	52	73.1%	26.9%

Table 1(A): TXA Administration in Total Knee Arthroplasty Cases

Comparison	Proportion Administered TXA	p-value	Statistical Significance
First Cycle vs. Second Cycle	48.8% vs. 73.1%	0.016	Statistically Significant

Table 1(B): Statistical Comparison of TXA Administration between Audit Cycles Regarding the combined administration of intravenous and topical TXA, there was a notable improvement. In the first cycle, combined administration was used in 3 (7.3%) cases, whereas this increased to 16 (30.8%) in the second cycle (p = 0.005). Table 2 presents a detailed breakdown of TXA administration methods.

Cycle	Intravenous (%)	Topical (%)	Combined (intravenous + topical) (%)	No TXA (%)	Total
Cycle 1	14 (34.1%)	3 (7.3%)	3 (7.3%)	21 (51.2%)	41
Cycle 2	22 (42.3%)	0 (0%)	16 (30.8%)	14 (26.9%)	52

Impact of tourniquet use: In the first audit cycle, among the nine patients who underwent total knee arthroplasty (TKA) without using a tourniquet, TXA was not administered in 4 (44.4%) cases. Conversely, in cases where a tourniquet was used, TXA was not administered in 16 (50%) of the cases. A negative correlation between tourniquet use and TXA compliance was observed in the second cycle. Specifically, in the cases where a tourniquet was used, TXA was not administered in 6 (50%) instances. On the other hand, the non-compliance rate decreased significantly to 20% (8 out of 40 patients) when a tourniquet was not employed. These findings are illustrated in **Table 3** and **Table 4**, which highlight the differences in TXA adherence based on tourniquet use.

Table 3: TXA Administration Based on Tourniquet Use (First Cycle)

Tourniquet Use	TXA Administered	TXA Not Administered	Total Cases	% TXA Administered	% TXA Not Administered
Used	16	16	32	50%	50%
Not Used	5	4	9	50%	44.4%

Table 4: TXA Administration Based on Tourniquet Use (Second Cycle)

Tourniquet Use	TXA Administered	TXA Not Administered	Total Cases	% TXA Administered	% TXA Not Administered
Used	6	6	12	50%	50%
Not Used	32	8	40	80%	20%

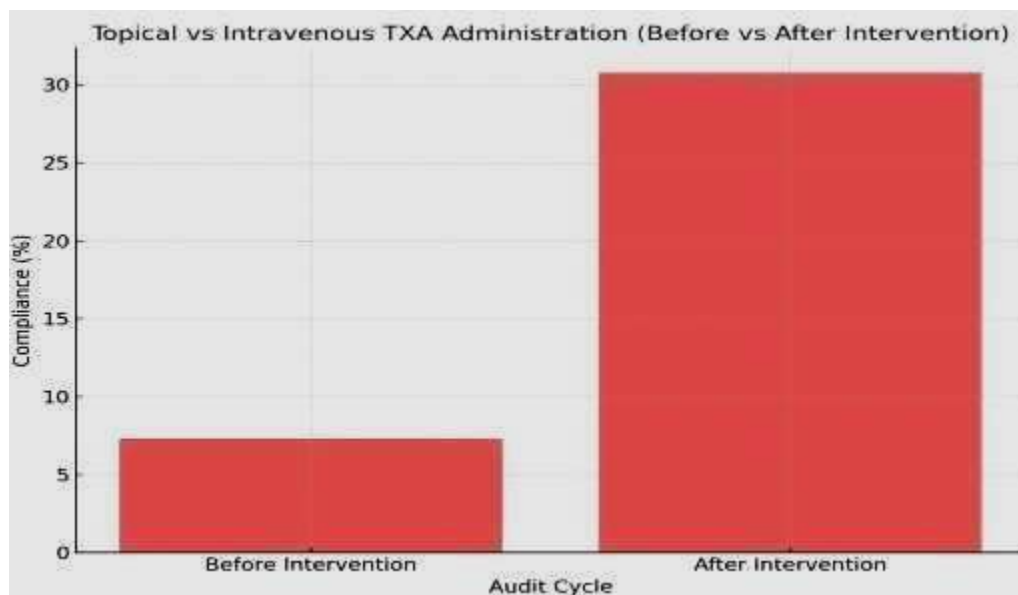
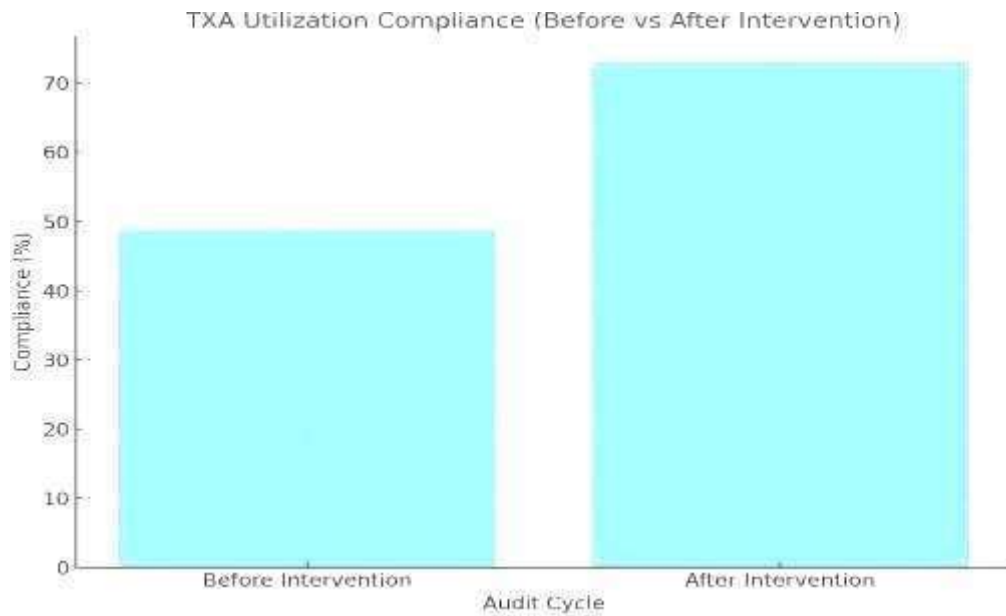
Impact of Renal Impairment: In the first audit cycle, nine patients had significant renal impairment, an estimated glomerular filtration rate (eGFR) ≤ 40 mL/min. Of these, only one patient received the recommended dose of 1 g of intravenous tranexamic acid (TXA). In the second cycle, the number of patients with significant renal impairment increased to 12. Among them, six (50%) did not receive TXA, and of the remaining patients who did receive TXA, five (41.7%) adhered to the guidelines and received only 1 g of intravenous TXA. One (8.3%) patient was administered a combined topical and intravenous TXA dose. Despite receiving a higher dose, this patient did not experience any adverse effects, and renal function remained stable post-procedure.

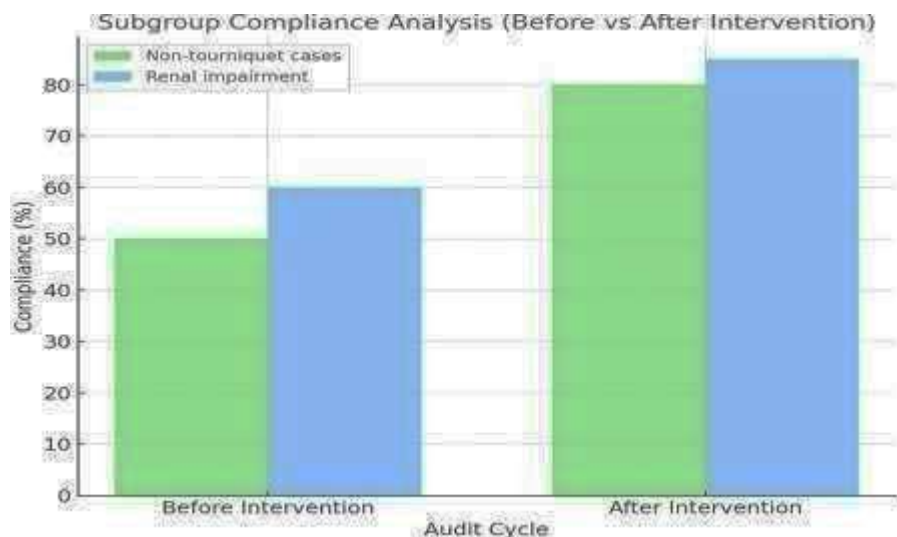
Evaluation and Enhancement Of Adherence to Tranexamic Acid....

Audit Cycle	Total Patients with Renal Impairment	TXA Not Administered	TXA Administered (Total)	Received Recommended 1g IV TXA	Received Combined IV & Topical TXA
First Cycle	9	8 (88.9%)	1 (11.1%)	1 (11.1%)	0 (0%)
Second Cycle	12	6 (50%)	6 (50%)	5 (41.7%)	1 (8.3%)

This data is presented in **Table 5**, which outlines the administration practices and outcomes for patients with renal impairment.

Table 5: TXA Administration in Patients with Significant Renal Impairment (eGFR $\leq$ 40 mL/min)





DISCUSSION

Despite CMH Abbottabad being a designated center for elective hip, knee, and shoulder arthroplasty, compliance with NICE guidelines for the use of tranexamic acid (TXA) in knee arthroplasties has been suboptimal among some of our hip and knee surgeons. The findings from this two-cycle audit highlight the positive impact of educational interventions in improving adherence to evidence-based practices. Statistically significant improvement in TXA compliance was observed between the first and second audit cycles, reinforcing that targeted educational strategies can address barriers to compliance effectively. A prospective randomized control trial conducted by Huang et al. demonstrated that patients treated with both intravenous and topical TXA experienced reduced blood loss⁸, less postoperative knee swelling, reduced pain, enhanced early knee function⁹, and higher satisfaction following total knee arthroplasty (TKA) when compared to procedures using a tourniquet. Moreover, even when a tourniquet was employed, adding TXA reduced blood loss, a lower risk of blood transfusion, and a decreased incidence of pulmonary embolism¹⁰. In the first audit cycle at CMH, TXA was not utilized in 50% of surgeries performed without a tourniquet (five out of ten cases), a rate identical to the non-compliance observed in cases where a tourniquet was used (16 out of 31 cases, 50%). However, the second audit cycle revealed a pivotal role of TXA in enabling surgeries to proceed without a tourniquet. Noncompliance with TXA dropped significantly to 20% (eight out of 40 cases) when no tourniquet was employed, compared to 50% (six out of 12 cases) in surgeries involving a tourniquet. These results suggest that adherence to TXA guidelines directly facilitated the avoidance of tourniquet use³, providing further advantages, such as mitigating the risks associated with tourniquet-related complications.

Tourniquet use in TKA is known to increase the risk of thromboembolic events, postoperative pain, and prolonged rehabilitation. In contrast, deflating the tourniquet after wound closure to minimize blood loss can limit the benefits of topical TXA due to an absence of active hemostasis. Moreover, prolonged tourniquet use has been linked to an increased risk of deep vein thrombosis (DVT)⁴, which may contribute to reluctance to use TXA in patients undergoing surgery under tourniquet control, with concerns that it could heighten the risk of DVT. A proposed strategy for improving compliance with TXA use at CMH is integrating TXA administration into the WHO surgical checklist⁵ for routine arthroplasty procedures. This checklist item would help ensure that anesthetic and surgical teams consistently administer TXA, reducing the chances of oversight or variation in practice. One of the key barriers to using TXA lies in its renal clearance pathway. This concern may contribute to hesitance in administering TXA to patients with renal impairment. To address this issue, targeted educational interventions should focus on the safety of administering 1g intravenous TXA⁷, even in patients with significant renal impairment, as recommended by the NICE guidelines. This can help alleviate unfounded concerns regarding the safety of TXA in this patient population.

Limitations of the study: The limitations of our study include the relatively small sample size and the retrospective design. Additionally, the two cycles conducted within a short time frame hinder evaluating the sustainability of improvements or long-term compliance trends. Future studies would benefit from a larger cohort, allowing for more robust subgroup analyses, especially in cases with confounding factors such as renal impairment or the use of a tourniquet. While our study emphasizes the potential impact of targeted educational interventions on improving compliance, it does not.

explore in detail the reasons for surgeons' and anesthetists' deviations from the guidelines. These deviations could stem from concerns about safety, a lack of familiarity with NICE guidelines, or other unexamined factors. Further investigation into these issues would be valuable for guiding future interventions at CMH Abbottabad.

CONCLUSION

this audit demonstrates the significant potential of targeted educational interventions in improving adherence to evidence-based guidelines. By refining the practices surrounding TXA administration, surgeons can enhance patient outcomes and minimize blood loss, aligning with national standards for total knee arthroplasty. These efforts deliver high-quality, evidence-driven care at CMH Abbottabad, ensuring patient safety and outcomes. Continuous education and regular audits will be essential in maintaining and improving compliance with established guidelines.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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