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The Significant Effect of Administering Tranexamic Acid Intraoperatively on The Scoring of Ecchymosis in Various Timeframes of Rhinoplastic Procedures

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Abstract

Objectives: The study aimed to assess the impact of procedural timeframe in minutes on the probability of post-rhinoplastic ecchymosis. It was conducted using a binary logistic regression analysis and multiple logistic regression analysis to examine the relationship between the duration of patients' procedures and the likelihood of post-procedural ecchymosis. The study also introduced a major binary state of comparison, the non-experienced TXA cohort versus the experienced TXA cohort, to the previous binary logistic regression analysis.

Methods:A study involving patients who had undergone various rhinoplastic procedures was conducted. Patients excluded due to previous surgery, cardiovascular or coagulopathy disorders, uncontrolled bold pressure, or being younger than 18 or older than 60 years old or requiring an additional osteotomy were also excluded. The study obtained approval from the Institutional Review Board/Human Subjects Committee of the Faculty of Medicine-Hashemite University. Patient information was obtained through retrospective review of

hospital records. The primary result was the evaluation of periorbital ecchymoses following surgery using the grading system developed by Kara et al. The study divided eligible patients into binary cohorts based on TXA, with Group I not receiving intraoperative TXA IV and Group II receiving TXA IV. The statistical correlation between the duration of rhinoplastic procedures and the severity of post-procedural ecchymosis was analyzed using ROC curve analysis. A binary. Multiple, and cox regressional statistical analysis were also conducted in this study.

Results: The optimal rhinoplastic procedure for the Jordanian cohort was determined at 100.50 minutes, with a probability of post-rhinoplastic ecchymosis >3 at the explored optimal point being 50.02%.The study also found that the primary binary variable of investigation, TXA experiencing, was significantly linked to a lower risk of having a higher ecchymosis risk when given intraoperatively. The addition of binary interventional TXA therapy improved the corresponding sensitivity, specificity, positive and negative predictive values, as well as the accuracy index by 70.1%, 71.2%, 71.6%, 69.6%, and 70.6%, respectively.The study also investigated the impact of provision intraoperatively of TXA IV against the probability of a post-rhinoplastic ecchymosis score exceeding 3 while considering the procedural duration timeframe in minutes across patients' age strata via cox-regressional proportional hazard modelling. The adjusted odd ratio for having a post-rhinoplastic ecchymosis score >3 when an intraoperative TXA IV was provided versus a non-experiencing TXA IV in a comparative cohort was significantly determined at 0.417 (95% CI; 0.283–0.614).

Conclusion: Multiple logistic regression and cox-regressional proportional hazard modelling showed that intraoperative TXA IV reduced the probability of post-rhinoplastic ecchymosis scores exceeding grade 3 across various attended patients' ages and procedural timeframes.

INTRODUCTION

Rhinoplasty, defined as a surgical reconstruction of the nose to modify dynamic and anthropometric elements, is a popular aesthetic procedure. Indications for surgery can include cosmetic and functional causes, such as hump resection, osteotomies, tip modification, septoplasty, and turbinoplasty. Indeed, it changes the projection, length, angle, tip, and size of the nose, as well as the size of the nostrils.[1-3]

Rhinoplastic procedures are typically associated with pain and a significant risk of bleeding, particularly in areas like the osteotomy region. This can lead to common complications such as ecchymosis and subconjunctival haemorrhages, which can negatively impact both physical and psychological outcomes. Additionally, other post-procedural complications such as nausea or vomiting and discomfort during coughing can also occur. In other words, rhinoplastic procedures can lead to a difficult and prolonged postoperative period.[4-6]

The goal of reducing or preventing bruising after rhinoplasty is to speed up the patient's recovery, which is often the limiting factor in this procedure. Efficient and focused treatment to reduce and treat bruises in rhinoplasty is important in cases where the patient is exposed to the public or media, as it can lead to faster social reintegration and less impaired participation in professional activities.[7-9]

To prevent and manage ecchymosis in rhinoplasties using tranexamic acid, a synthetic derivative of lysine. Various surgeries commonly use tranexamic acid due to its higher antifibrinolytic effects with significantly lower risk of thromboembolism. Tranexamic acid

(TXA) is a synthetic derivative of lysine that competitively inhibits plasminogen activation at the lysine binding sites, making crosslinked fibrin relatively resistant to fibrinolysis. Its ability to reduce posttraumatic and surgical bleeding is mainly related to its capacity to stabilize the fibrin coat formed. TXA also exerts interesting effects on the anaphylactic process by counteracting the potentiation of histamine and serotonin release simultaneously with the inhibitors of fibrinolysis and the prostaglandin-synthesis inhibitors. Tranexamic acid (TXA) has been shown to reduce ecchymosis after nearly all surgical rhinoplasty techniques, including open, closed, and both hump and tip surgery. [10-14]

The evidence-based mini-review indicates that TXA successfully hindered and alleviated marked hemostasis and ecchymosis in the faction of patients who undergo rhytidectomy, abdominoplasty, or breast modal operations. Rhinoplasty is one of the most adopted procedures, and ecchymosis and swelling remain a significant concern for both surgeons and patients. Different fully allopathic and complementary medications can be applied for this purpose, but identifying the most promising one with fewer side effects, better effectiveness, quicker action on a precise mechanism, a more extended shelf-life, or better results would be substantial.[15-18]

Nevertheless, comprehensive reporting of the use of TXA in rhinoplasty to minimize ecchymosis is not widespread. For instance, most studies conducted on TXA have not considered all potential confounding factors, such as anthropometrical and nutritional statuses, multivitamins and minerals supplementation, thermoplastic or alternative treatments, corticosteroidal administrations, and others. It is important to evaluate the effects of TXA as an antifibrinolytic treatment in order to reduce the negative outcomes of post-rhinoplastic surgery, specifically ecchymosis, eyelid edoema, and subconjunctival haemorrhages. [19-20]

The point of this study was to find out if injecting tranexamic acid (TXA IV) during rhinoplasty surgeries is a good idea. More specifically, it was wanted to know if it would help reduce the severity of bruising, as measured by the post-rhinoplasty ecchymosis scoring system (which goes from 0 to 4). The study also took into account the varying durations of the procedures. In this study, we aimed to investigate various aspects beyond the ecchymosis score cutoff threshold. Our other objective was to develop binary and multiple logistic regression models and compare them. In this study, we also examined various comparative variables and compared their rates between two binary states of TXA experiencing. We then included the statistically significant variables in our cox-regressional proportional hazard modelling.

METHODS AND MATERIALS

At the Hashemite University in Zarqa, Jordan, between the years 2019 and 2023, a retrospective, observational, and non-sponsored study was carried out. The study included patients who were present and had undergone a variety of rhinoplastic procedures. Patients who had previously undergone revision surgery or previous maxillofacial intervention, had a history of cardiovascular or coagulopathy disorders, or had uncontrolled bold pressure were excluded from the study. In addition, patients who were either younger than 18 years old or older than 60 years old, as well as patients who required an additional osteotomy during surgery for rocker or step deformities on either side, were not included in the study. In the case of female patients, they were given the instruction to coordinate their surgical procedures for a period of time following their menstrual cycle.

This study obtained approval from the Institutional Review Board/Human Subjects Committee of the Faculty of Medicine-Hashemite University. Due to the retrospective design of this study, the requirement for informed consent was waived. The patient information was obtained by retrospectively reviewing hospital records. This included data on the patients' demographics, anthropometrics, comorbidity burden (measured by age-adjusted comorbidity

index), use of tranexamic acid, dexamethasone, and multivitamins, type of splinting used after rhinoplasty (thermoplastic or non-thermoplastic), scores assessing post-procedural complications, and the duration of the rhinoplasty procedure in minutes. Indeed, the information pertaining to each and every patient was anonymized and then stored in a safe location.

Throughout the procedure, all patients were fitted with nasal packing that was not tightly compressed. Furthermore, all patients were given postoperative instructions. The patients were prescribed a course of antibiotics for a period of 5 days, while analgesics were prescribed until the patient's pain reached a manageable level. Furthermore, all patients were advised to raise the head. The primary result of this study was the evaluation of periorbital ecchymoses following surgery. The clinical evaluation of periorbital ecchymosis was performed based on the presence of the "Raccoon sign," characterised by the appearance of dark purple to blue bruising beneath the eye. The grading system developed by Kara et al [21-22] was employed to evaluate the scoring of periorbital ecchymosis (**Figure 1).**

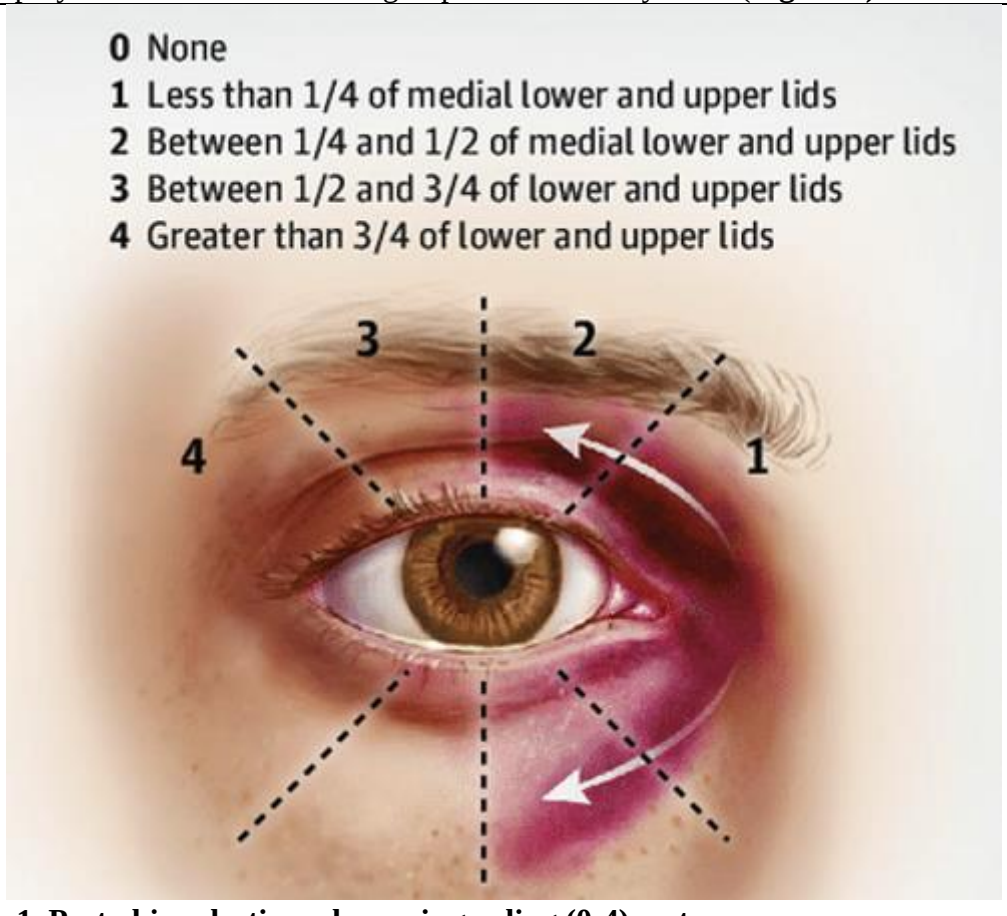

Figure 1. Post-rhinoplastic ecchymosis grading (0-4) system.

The grading system for post-rhinoplastic ecchymosis ranges from 0 to 4, with higher values indicating more severe ecchymosis. A score of 0 indicates the absence of ecchymosis. A score of 1 indicates ecchymosis limited to the medial half, without involvement of the lateral quarters. A score of 2 indicates ecchymosis involving the lower and/or upper medial quarters, without involvement of the lateral quarters. Score 2 is characterised by ecchymosis in the lower and/or upper medial quarters, as well as the lower lateral quarter, but not in the upper lateral quarter. The score of 3 indicates that there is ecchymosis present in all four quarters and it is between ½ to ¾ of lower and upper eyelids. Score 4 indicates that ecchymosis is greater than ¾ of lower and upper eyelids. The primary surgeon evaluated the

patient on the first day after surgery before discharge. Subsequently, the patient was assessed during follow-up visits at 7, 14, and 21 days after the surgery in the outpatient clinic. The outcomes of the evaluations carried out during each follow-up appointment after surgery.

The eligible patients who were studied were initially divided into binary cohorts based on TXA. The initial cohort, referred to as Group I, did not receive intraoperative TXA IV. In contrast, the comparative cohort, known as Group II, did receive TXA IV. The two groups, categorised based on their relationship to TXA, were used as the dependent variable for comparison. The distribution rates of other independent variables were analysed across Group I-II using a chi-square test. In addition, we utilised the chi-square test to calculate the corresponding odds ratio (if statistically applicable), chi-square significance ($\chi 2$ (df)), Pearson correlation, and p-value for each variable that was tested.

Subsequently, we analysed the statistical correlation between the duration of rhinoplastic procedures in minutes and the severity of post-procedural ecchymosis (PRE) in patients. We examined this relationship at two different thresholds: PRE>2 and PRE>3. In the initial situation, we classified patients with PRE scores of 3 and 4 as being in a positive state, which we represented as 1. Conversely, scores of 0-2 were classified as negative states and represented as 0. In the second analysis scenario, we classified a patient's PRE score of 4 as a positive state, while PRE scores ranging from 0 to 3 were considered negative states. We performed receiver operating characteristic (ROC) curve analysis for both case scenarios to determine the area under the ROC curves, along with their standard error of means (AUROC±SEM) and 95% confidence interval ranges (95% CI: LL-UL). We utilised the serial values of the procedural timeframes, along with their corresponding false positive values, to represent the other sensitivity indices at the optimal operating cutoff value during sensitivity analysis. The optimal procedural duration timeframe was picked via examining youden's J statistic.These sensitivity indices at the highest picked youden index (YI) included each of true positive rate (TPR) or sensitivity, true negative rate (TNR) or specificity, positive and negative predictive values (PPV and NPV), negative likelihood ratio (NLR), and accuracy index (AI). Therefore, a binary logistic regression analysis was performed to examine the variables that showed statistical significance in the ROC analyses.

The purpose of the binary logistic regression analysis was to assess the extent to which the procedural timeframe in minutes can predict the probability of post-rhinoplastic ecchymosis. The analysis aimed to obtain the coefficients needed to create a regression model and to examine various overall performance measures such as true positive rate (TPR), true negative rate (TNR), accuracy index (AI), positive predictive value (PPV), and negative predictive value (NPV) for estimating the risk of ecchymosis. A regression analysis was conducted to examine the relationship between the duration of the patients' procedure in minutes and the likelihood of post-procedural ecchymosis. The analysis was based on a constructed model, and the probability of ecchymosis risk was determined at a specific cutoff point.

In this study, we thereafter introduced our major binary state of comparison, the non-experienced TXA cohort versus the experienced TXA cohort, to the previous conducted binary logistic regression via processing a multiple logistic regression analysis that aimed to address the regressional impact of TXA intervention in association with the procedural timeframes for prognosticating the probability of post-procedural ecchymosis risk. Correspondingly, the abstracted explained variations, the model related performances indices, and the necessary coefficients for the multiple logistic regression analysis were compared to the yielded results in the binary logistic regression analysis without addressing the TXA impactful effects.

To address the adjusted impactful of experiencing TXA in attended patients for rhinoplastic procedures taking into the account each of procedural timeframes in minutes and the outcome of interest in this study (post-procedural ecchymosis risk) across the significant distributed independent tested variables' strata, we pursued a cox-regressional proportional hazard modelling analysis in aimed to explore the adjusted hazard risk significance for provision intraoperatively TXA IV compared to non-experiencing cohort in accompanied with its 95% confidence interval and to express the rates of ecchymosis risk across the each stratum of the analyzed strata.

This study utilised Microsoft Office LTSC Professional Plus 2021 Excel for data collection and filtering of patients' data. IBM SPSS Statistics version 25 was employed for statistical analysis. This study employed a significance level of 0.05.

RESULTS

A total of 269 patients underwent testing and attended appointments for rhinoplasty surgery. Out of the total number of patients who attended, approximately 49.81% (134 patients) underwent rhinoplastic surgery without receiving 1 gramme of tranexamic acid intravenously at the start of the procedure. This group is referred to as Group I. By contrast, around 50.19% (135 patients) received intravenous administration of 1-gram tranexamic acid during surgery (Group II).

The study found that the rates of post-rhinoplastic ecchymosis (bruising) and swelling were 91.8% and 52.8% for scores greater than 2, and 8.2% and 47.2% for scores less than or equal to 2, respectively. The rates of post-rhinoplastic swelling incidences were not significantly different between Group I and Group II. For scores greater than 2, the rates were 50.0% in Group I and 55.6% in Group II. For scores less than or equal to 2, the rates were 50.0% in Group I and 44.4% in Group II. The statistical analysis using the chi-square test showed that the difference in rates was not statistically significant (chi-square = 0.833, p-value = 0.361). Similarly, the odds ratio and correlation for a higher score in post-rhinoplastic swelling were determined to be 1.250 (95% confidence interval; 0.77-2.02) and 0.056±0.061, respectively.

The statistical analysis showed that there was a significant difference in the distribution rates of post-rhinoplastic periorbital ecchymosis scores between Group I and Group II. Specifically, for scores greater than 2, 100% of Group I had these scores compared to 83.7% of Group II. On the other hand, for scores less than or equal to 2, none of Group I had these scores while 16.3% of Group II did. The chi-square test statistic was 23.782 with a p-value of 0.000. In this study, we discovered a significant, moderate, and negative correlation (-0.297±0.033) between higher ecchymosis scores in patients who received intravenous tranexamic acid (TXA) during surgery, compared to patients who did not receive TXA.

A total of 143 females (53.2%) and 126 males (46.8%) participated in this study. The gender distribution rates in Group I-II were not statistically significant, with 67 (50.0%) males and 67 (50.0%) females in comparison to 59 (43.7%) males and 76 (56.3) %) females, respectively ($\chi 2$ (1) =1.071, p-value=0.301). The gender's odd ratio and correlation among Group I-II were found to be 0.776 (95% CI; 0.48-1.25) and -0.063±0.061, respectively.

In the study, the investigated patients' age categories were significantly distributed across the non-TXA cohort and the TXA cohort, with the highest rate of 70 (52.2%) followed by 30 (22.4%) and 24 (17.9%) for 26-35 years, 18-25 years, and 36-45 years, respectively, versus 52 (38.5%), 47 (34.8%), and 32 (23.7%) for 18-25 years, 26-35 years, and 36-45 years, respectively ($\chi 2$ (4) = 14.730, p-value = 0.005). These patients' age ranges were also significantly, negatively, and weakly correlated by -0.122±0.059 among Groups I–II.

While considering comorbidity burden differences between the two compared rhinoplastic surgeries cohorts, a statistically insignificant was concluded for the age adjusted charlson

comorbidity index scores 0-6 ($\chi 2$ (6) =9.043, p-value=0.171). When examining the differences in comorbidity burden between the two groups undergoing rhinoplastic surgeries, it was determined that there was no statistically significant difference in the age-adjusted Charlson comorbidity index scores ranging from 0 to 6 ($\chi 2$ (6) =9.043, p-value=0.171).

The obesity rates of the tested patients, as determined by their body mass indexes, were evenly distributed across Group I-II. Specifically, 62 patients (46.3%) had normal body weight indexes in Group I, compared to 71 patients (52.6%) in Group II. Similarly, 72 patients (53.7%) had over body weight indexes in Group I, compared to 64 patients (47.4%) in Group II. This distribution was found to be statistically insignificant ($\chi 2$ (1) =1.076, p-value=0.300). The odd ratio and pearson correlation were reported as 0.776 (95% confidence interval: 0.48-1.25) and -0.063±0.061, respectively.

In addition to the primary pharmacotherapeutic investigation of Tranexamic acid (TXA), some of the patients we studied also had a positive history of regular multivitamins (MVs) supplementation. Furthermore, they received preoperative intravenous dexamethasone (Dex IV) administration, with or without postoperative administration. Both preoperative regular multivitamin supplementation and preoperative ± postoperative intravenous administration of dexamethasone may have a beneficial impact on the occurrence of ecchymosis and swelling after rhinoplastic procedures.

Regarding Dex IV, there was a statistically insignificant distribution across non-TXA vs. TXA groups of 66 (49.3%) and 68 (50.7%) vs. 75 (55.6%) and 60 (44.4%) for non-administered Dex IV and administered Dex IV, respectively ($\chi 2$ (1) = 0.626, p-value = 0.429). While in the case of experiencing regular MVs, there were also statistically insignificant distribution rates across Groups I–II of 66 (49.3%) and 68 (50.7%) vs. 73 (54.1%) and 62 (45.9%) for negative history and positive history of postoperative regular MVs supplementations, respectively ($\chi 2$ (1) = 0.626, p-value = 0.429).

Thermoplastic splints have traditionally been used to help otorhinolaryngologist surgeons effectively manage post-rhinoplastic complications, such as periorbital bruising, eyelid swelling, and nostril adhesions. In our study, the overall utilisation rate of postoperative thermoplastic splints was 54.6%, while the utilisation rate of traditional splints was 45.4%. However, we did not find a statistically significant preference for the use of thermoplastic splints over non-thermoplastic splints in post-rhinoplastic surgery patients in Group I-II [75 (56.0%) and 59 (44.0%)) vs (72 (53.3%) and 63 (46.7%), $\chi 2$ (1) =0.189, p-value=0.664]. **Table 1** presents the chi square test analyses of the studied variables across the non-TXA-experienced cohort (Group I) and the TXA-experienced cohort (Group II).**Figure 2** presents the bar charts that illustrate the variables under study in both Group I-II.

We conducted a receiver operating characteristic (ROC) curve to explore the clinical impacts of the rhinoplastic procedure timeframe in minutes against the post-rhinoplastic ecchymosis risk, and we adopted two proposed score thresholds. Firstly, we investigated the ecchymosis score threshold of >2 (positive state and signed as 1) versus ≤2 (negative state and signed as 0). Second, we adopted an ecchymosis score threshold of >3 (positive state and signed as 1) versus ≤3 (negative state and signed as 0). In the first scenario, the positive state cases were 247, and the negative state cases were only 22. The yielded area under the ROC curve (AUROC) was calculated at 0.596±0.054 (95% CI: 0.489–0.702) with a P-value of 0.137. Although the ecchymosis score threshold of 2 was statistically insignificant, the ecchymosis score threshold of 3 in contrast revealed statistically significant clinical utility at AUROC±SEM (95% CI; LL-UL) of 0.601±0.034 (95% CI; 0.533-0.668), P-value = 0.004. The positive state cases in the second scenario were 137, and the corresponding negative state cases were 132. **Figures 3** and **4** present the ROC curve analyses for the procedural duration time frames in minutes against post-rhinoplastic ecchymosis scores >2 and >3.

We conducted both binary logistic regression and sensitivity analyses in conjunction with the ROC curve analyses to determine the necessary coefficients for building the regressional model, the variability range and quality of prediction, and the optimal procedural timeframe, along with its corresponding sensitivity indexes. The explained variations in the probability of a post-rhinoplastic ecchymosis score >3 instead of ≤3 based on our constructed model ranged between 3% and 4.1%, depending on whether we referenced the Cox & Snell R^2 or Nagelkerke R^2 methods, respectively, [$\chi 2$ (8) = 8.138, p-value=0.420]. The constructed binary logistic regression model was formulated as %Prob PRE>3=e (-5.828+0.058×Duration)/ [1+(e 5.828+0.058×Duration)]. We determined the optimal rhinoplastic procedure for our studied Jordanian cohort at 100.50, achieving a sensitivity, specificity, positive and negative predictive values, negative likelihood ratio, and youden and accuracy indexes of 59.9%, 56.82%, 58.99%, 57.69%, 70.66%, 16.67%, and 58.36% respectively. The study revealed that the probability of post-rhinoplastic ecchymosis >3 at the explored optimal point (100.1 minutes) was 50.02%. Our constructed binary logistic regression model, at an optimal procedural timeframe of 100.5 minutes, revealed a lower sensitivity compared to the overall estimated sensitivity (59.9% vs. 63.5%). However, the yielded specificity, positive and negative predictive values, and accuracy index were higher than the corresponding overall estimates [(56.82% vs. 50%), (58.99% vs. 56.9%), (57.69% vs. 56.9%), and (58.36% vs. 56.9%), respectively]. **Figure 5** presents the binary logistic regression illustration with its accompanied overall and sensitivity indices results for the procedural timeframe in minutes against the post-rhinoplastic ecchymosis score > 3.

When we introduced the primary binary variable of investigation in this study, the TXA experiencing, as an adjunct to the patients' procedural duration timeframe in minutes while conducting a multiple logistic regression analysis, we resulted in a regressional model that explained higher variations in the probability of a post-rhinoplastic ecchymosis score >3. This score ranged between 19.1% and 25.5%, depending on whether we referenced the Cox & Snell R2 or Nagelkerke R2 methods. The multiple logistic regression model we made, which was written as %Prob PRE>3= e (-6.068-1.825 TXA+0.070àDuration)/ [1+ e (-6.068-1.825×TXA+0.070àDuration)], showed that giving TXA intraoperatively was significantly linked to a lower risk of having a higher ecchymosis risk, with a magnitude ± standard error of -1.825±0.277 or an estimate ratio of 0.161 at a fixed procedure timeframe. When comparing the multiple logistic regression analysis to the binary logistic regression analysis that was already done, the procedure time increased the risk of having higher ecchymosis by 0.070±0.023 per minute compared to 0.058±0.021 per minute. The addition of binary interventional TXA therapy to our models improved the corresponding sensitivity, specificity, positive and negative predictive values, as well as the accuracy index, by 70.1%, 71.2%, 71.6%, 69.6%, and 70.6%, respectively, compared to 63.5%, 50%, 56.9%, 56.9%, and 56.9%. Figure 6 fully presents the multiple logistic regression illustration and its corresponding results.

In the previous chi square analysis results, we revealed that only the studied patient age categories had significantly higher distribution rates across the non-TXA experiencing cohort (Group I) and the TXA experiencing cohort (Group II). Accordingly, we also investigated the impact of provision intraoperatively of TXA IV against the probability of a post-rhinoplastic ecchymosis score exceeding 3 while considering the procedural duration timeframe in minutes across patients' age strata via cox-regressional proportional hazard modelling. According to this conducted test, the actual %TXA experiencing cohort was 51.30% (137 patients), in contrast to the %TXA experiencing rate as indicated by the conducted chi square test, n = 135, (50.19%). The differences in two cases were considered dropped. However, the stratification TXA experienced rates according to the patient age strata were 47.6%, 50.4%,

50.90%, 71.4%, and 100% for 18–25 years, 26–35 years, 36–45 years, 46–55 years, and >55 years, respectively. The adjusted odd ratio for having a post-rhinoplastic ecchymosis score >3 when an intraoperative TXA IV was provided versus a non-experiencing TXA IV in a comparative cohort while considering the rhinoplastic procedural duration timeframe and patients' age strata was significantly determined at 0.417 (95% CI; 0.283–0.614), p-value = 0.000, $\chi 2$ (1) = 21.166, p-value<0.001. **Figures 7-8** present the conducted cox-regressional proportional hazard modelling results and illustrations.

DISCUSSION

Multiple methods are used for each rhinoplastic procedure. Lateral osteotomy mobilises the lateral nasal wall, repairs an open roof defect after hump resection, or narrows the nasal dorsum. Rhinoplasty is essential for correcting a deviated nose and creating symmetry by changing the relationship of the lateral nasal walls to each other and to the facial skeleton. Rhinoplasty techniques depend on the surgeon's experience. Rhinoplasty, a popular cosmetic and functional surgery, is prone to bleeding and swelling complications. Jordanians have high rates of rhinoplasty due to affordability and surgical advances. Aesthetic facial plastic surgery often causes postoperative swelling and bruising, which can stress patients and limit their social life.[23-25]

Surgeons and patients must consider postoperative morbidity. As mentioned in the introduction, periorbital complications—mainly edoema, ecchymosis, and subconjunctival hemorrhage—are the most frustrating rhinoplastic complications. Damage to the internal mucosal lining, periosteum, subcutaneous tissue, and angulular artery around the bony site targeted for rhinoplastic procedures appears to be their cause. Some researchers suggest elevating the peri-osteum to limit sequelae, but sweeping injury could affect the surrounding subcutaneous tissue.[26-28]

In this retrospective study, we examined how tranexamic acid IV during procedural surgery mitigated post-procedural complications, specifically ecchymosis, which was graded 0-4. We show these impactful outcomes alongside procedural timeframes, which is interesting. Antifibrinolytic agents have reduced blood transfusions in many surgical fields. Numerous systematic reviews and meta-analyses have shown that TXA reduces intraoperative bleeding and blood transfusions in major surgeries without increasing the risk of renal failure or thromboembolic events.

Tranexamic acid and dexamethasone reduced periorbital edoema and ecchymosis in 60 primary open rhinoplasty patients, according to Mehdizadeh M et al. Patients were divided into four groups: D, T, DT, and P. The medications were injected intravenously 1 hour before and 3 times every 8 hours after surgery. The first, third, and seventh postoperative days were photographed digitally. Compared to the control group, groups D, T, and DT had significantly lower periorbital edoema and ecchymosis ratings. These groups did not significantly reduce or prevent periorbital edoema or ecchymosis. In open rhinoplasty, tranexamic acid and dexamethasone reduced periorbital edoema and ecchymosis similarly.[29]

In a study by Sakallioglu et al., TA and methylprednisolone were tested for their effects on periorbital edoema, ecchymosis, and intraoperative bleeding in patients undergoing open septorhinoplasty (oSRP). Control, oral TA, and single-dose methylprednisolone groups were formed. Patients taking TA and methylprednisolone had significantly lower periorbital edoema and ecchymosis scores than the control group. Periorbital edoema and ecchymosis prevention and reduction were not significantly different between groups. TA significantly reduced intraoperative bleeding compared to controls and methylprednisolone. Melprednisolone significantly reduced periorbital edoema and ecchymosis. TA was clinically and statistically effective in preventing bleeding and reducing periorbital edoema and ecchymosis in oSRP patients with osteotomies.[30]

Ghavimi MA et al measured the efficacy of Tranexamic acid (TXA) in rhinoplasty. Thirty patients received 10 mg/kg TXA before surgery, and 20 received normal saline. Intraoperative bleeding was measured gravimetrically, and haemoglobin and hematocrit were measured before and after surgery. Eyelid edoema and periorbital ecchymosis were scored 0-4. Surgeon satisfaction was assessed. The intervention and control groups had mean intraoperative bleeding of 213 and 254 mL, respectively, in 50 patients. TXA did not affect haemoglobin levels, but pre- and post-op differences were observed. TXA significantly affected eyelid edoema, periorbital ecchymosis, and surgeon satisfaction. Finally, 10 mm/kg TXA reduced intraoperative bleeding, eyelid edoema, and periorbital ecchymosis in rhinoplasty with minimal side effects.[31]

Gutierrez RW et al. examined TXA's effects on rhinoplasty patients in a systematic review and meta-analysis. TXA decreased blood loss, periorbital edoema, and ecchymosis and increased surgeon satisfaction. The study included 11 studies with 841 patients. On postoperative day one, TXA reduced edoema and ecchymosis and increased surgeon satisfaction. Surgery duration was unchanged. The study found that TXA reduced blood loss, periorbital edoema, and ecchymosis and improved surgeon satisfaction. These findings suggest that plastic surgeons may use TXA to optimise rhinoplasty management. The findings suggest that TXA may be a better treatment for rhinoplasty patients, particularly those with underlying health issues.[32]

Tranexamic acid (TXA) administered locally through lateral osteotomy lines was examined for its effects on postoperative periorbital edoema and ecchymosis by Ipek HD et al. Thirty patients had narrow subperiosteal tunnels opened before and after lateral osteotomies for open technical septorhinoplasty. Saline was injected into the left tunnel and TXA into the right tunnel with the broken tip. Blinded authors assessed periorbital edoema and ecchymoses. The TXA (+) group had significantly lower eyelid edoema on the third day and lower and upper eyelid ecchymosis on the first, third, and seventh days. The TXA (+) group had significantly lower upper eyelid edoema on the first and third days, but not on the seventh. Finally, septorhinoplasty with local TXA reduced postoperative periorbital edoema and ecchymosis.[33]

Ong AA et al. reviewed interventions to reduce postoperative edoema and ecchymosis after rhinoplasty. A systematic review of 50 articles examined corticosteroids, other drugs and herbal supplements, intraoperative bleeding, postoperative interventions, and surgical techniques. The consensus was that nasal packing and periosteal elevation before osteotomy increase edoema and ecchymosis, while steroids, intraoperative hypotension, cooling, and head elevation postoperatively decrease them. The review suggests using herbal supplements with minimal patient risk, but more research is needed before recommending an external or internal lateral osteotomy approach. The findings suggest more research is needed before recommending external or internal lateral osteotomy.[34]

A systematic review by Laikhter E et al examined how TXA affects bleeding and aesthetic outcomes in aesthetic plastic surgery. TXA was tested in rhinoplasty, rhytidectomy, liposuction, reduction mammaplasty, and blepharoplasty in 14 studies of 287 articles. Out of 820 patients, 446 (54.4%) received TXA. TXA reduced blood loss by 26.3 mL and postoperative hematoma risk, according to meta-analysis. However, other outcome reporting heterogeneity prevented meta-analysis. Five of seven studies found significantly decreased postoperative ecchymosis levels within 7 days of surgery, three showed significant drain output reductions, and one reported improved surgical site quality for TXA patients. TXA reduces blood loss and hematoma formation in aesthetic plastic surgery, which may improve patient satisfaction and lower complications like hematoma evacuation costs.[35]

In a prospective study from March to June 2019, Cristel RT et al. compared tranexamic acid (TXA) in reducing postoperative ecchymosis in rhinoplasty patients with and without TXA. The study quantified postoperative ecchymosis using Adobe Photoshop on 100 patients, 84 females and 16 males. The results showed no significant colour subgroup differences or TXA side effects. The study found that intravenous and intraoperative TXA injections did not reduce postoperative rhinoplasty ecchymosis. TXA is controversial due to side effects like seizures, blood clots, and vision changes.[36]

Our study revealed a weak but positive correlation between comorbidity burden score and TXA use (0.063 ± 0.061). Correlation was not statistically significant. In patients at risk of bleeding complications, this correlation may have overestimated TXA's effects. This may be allocation bias. However, the higher obesity rate, which is a risk factor for post-surgery bleeding, was not statistically significant in the group that did not receive TXA, which may balance the biassed impact of comorbidity burden between the investigated cohorts. Both co-administered potential confounders, Dex IV and MVs, were insignificantly allocated to the non-experienced TXA cohort (Group I) compared to Group II, which may clinically bias lower ecchymosis rates towards placebo effects over therapeutic effects. The odd ratios and correlations for Dex IV and MVs were [0.776 (95% CI; 0.48–1.25) and -0.063±0.061] and [0.824 (95% CI; 0.51–1.33) and -0.048±0.061], respectively. While statistically significant, using a thermoplastic splint instead of a traditional one after rhinoplasty may bias the non-TXA cohort towards placebo effects and underestimate the clinical usefulness of TXA in Group II patients. The odd ratio and correlation for choosing thermoplastic splints in Groups I-II were 0.899 (95% CI: 0.56–1.45) and -0.026±0.061, respectively. Although Tranexamic acid during surgery has consistently reduced eyelid swelling after rhinoplasty. This study found that patients who received 1 gramme of tranexamic acid during surgery had higher swelling scores, but not statistically significantly. As expected, Group I had higher proportional rates for Dex IV, MVs, and thermoplastic splint than Group II, which may explain these contradictory results.

Our retrospective design and single-center approach limited us, but we investigated a wide variable potential confounder and explored performance indices using a valid scoring system. We also used regressional modelling to abstract coefficients, sensitivity indices at optimal threshold, and adjusted hazard ratio significance.

CONCLUSION

Multiple logistic regression and cox-regressional proportional hazard modelling showed that intraoperative TXA IV reduced the probability of post-rhinoplastic ecchymosis scores exceeding grade 3 across various attended patients' ages and procedural timeframes.Further prospective studies should be conducted to evaluate the actual causality between the positive impact of intraoperative tranexamic acid IV and the potential adverse consequences for managing post-procedural complications.

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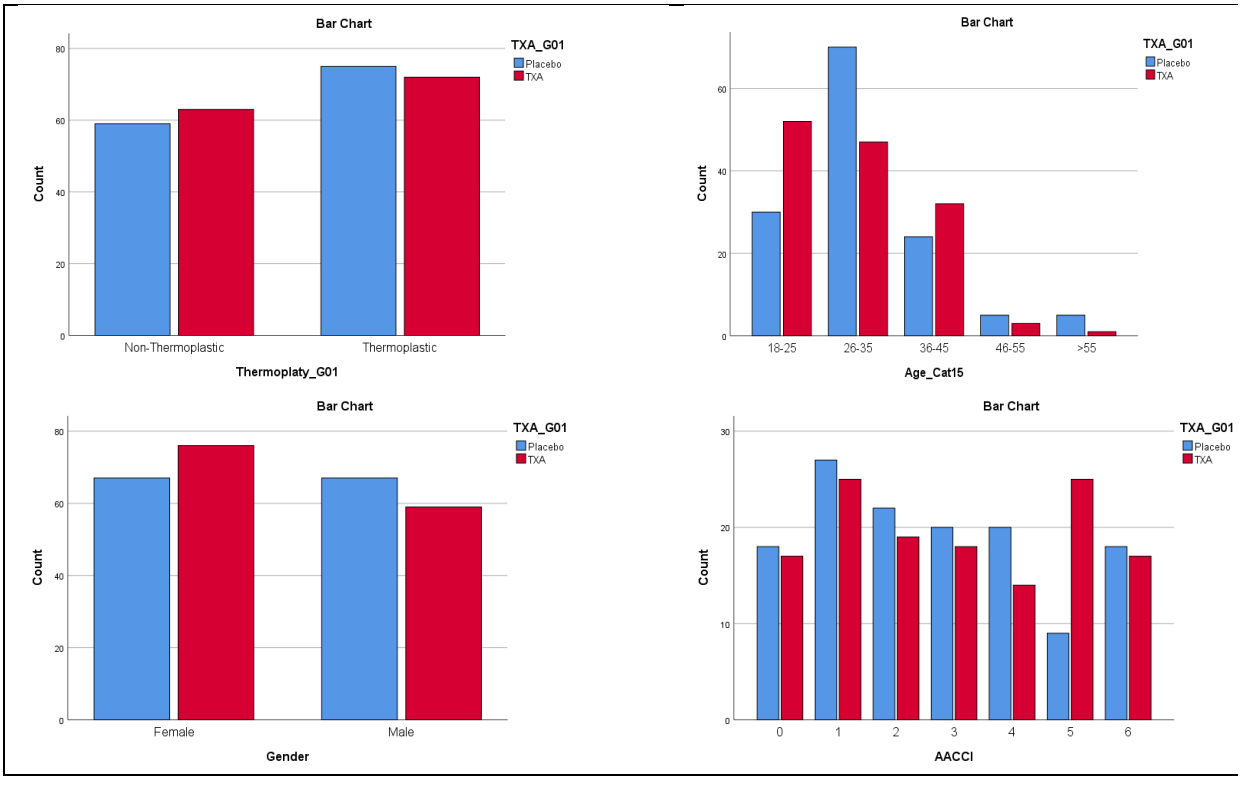
Table 1. Chi square analyses result across non-tranexamic acid and tranexamic acid groups.

	Non-TXA Group I n==134 (49.81%)	TXA Group II n=135 (50.19%)	Overall Cohort 269	Odd Ratio	$\chi 2$ (df) p-Value	R±SEV
Age (Years)						
18-25	30 (22.4%)	52 (38.5%)	82 (30.5%)	NA	14.730 (4) 0.005*	-0.122±0.059**
26-35	70 (52.2%)	47 (34.8%)	117 (43.5%)			
36-45	24 (17.9%)	32 (23.7%)	56 (20.8%)			
46-55	5 (3.7%)	3 (2.2%)	8 (3.0%)			
>55-60	5 (3.7%)	1 (0.7%)	6 (2.2%)			
Gender						
Female	67 (50.0%)	76 (56.3%)	143 (53.2%)	0.776 (95% CI; 0.48-1.25)	1.071 (1) 0.301	-0.063±0.061
Male	67 (50.0%)	59 (43.7%)	126 (46.8%)			
AACCI						
0	18 (13.4%)	17 (12.6%)	35 (13.0%)	NA	9.043 (6) 0.171	0.063±0.061
1	27 (20.1%)	25 (18.5%)	52 (19.3%)			
2	22 (16.4%)	19 (14.1%)	41 (15.2%)			
3	20 (14.9%)	18 (13.3%)	38 (14.1%)			
4	20 (14.9%)	14 (10.4%)	34 (12.6%)			
5	9 (6.7%)	25 (18.5%)	34 (12.6%)			
6	18 (13.4%)	17 (12.6%)	35 (13.0%)			
Dex						
No	66 (49.3%)	75 (55.6%)	141 (52.4%)	0.776 (95% CI; 0.48-1.25)	1.071 (1) 0.301	-0.063±0.061
Yes	68 (50.7%)	60 (44.4%)	128 (47.6%)			
MVs						
No	66 (49.3%)	73 (54.1%)	139 (51.7%)	0.824 (95% CI; 0.51-1.33)	0.626 (1) 0.429	-0.048±0.061
Yes	68 (50.7%)	62 (45.9%)	130 (48.3%)			
Obs statues						
No	62 (46.3%)	71 (52.6%)	133 (49.4%)	0.776 (95% CI; 0.48-1.25)	1.076 (1) 0.300	-0.063±0.061
Yes	72 (53.7%)	64 (47.4%)	136 (50.6%)			

Thermoplastic Splint						
No	59 (44.0%)	63 (46.7%)	122 (45.4%)	0.899 (95% CI; 0.56-1.45)	0.189 (1) 0.664	- 0.026±0.061
Yes	75 (56.0%)	72 (53.3%)	147 (54.6%)			
Swelling Score						
0-2	67(50.0%)	60(44.4%)	127(47.2%)	1.250 (95% CI; 0.77-2.02)	0.833 (1) 0.361	0.056±0.061
3-4	67(50.0%)	75(55.6%)	142(52.8%)			
Ecchymosis Score						
0-2	0 (0.0%)	22 (16.3%)	22 (8.2%)	2.186 (95% CI; 1.91-2.50)	23.782 (1) 0.000*	-0.297±0.033**
3-4	134 (100%)	113 (83.7%)	247 (91.8%)			

TXA: Tranexamic acid. **MV**s:Multivitamins supplement.
Dex: Dexamethasone. **AACCI:** Age adjusted charlson comorbidity index.
Obs: Obesity statues. **R:** Pearson correlation.
n: Number of tested patients. **SEV:** Standard error of value



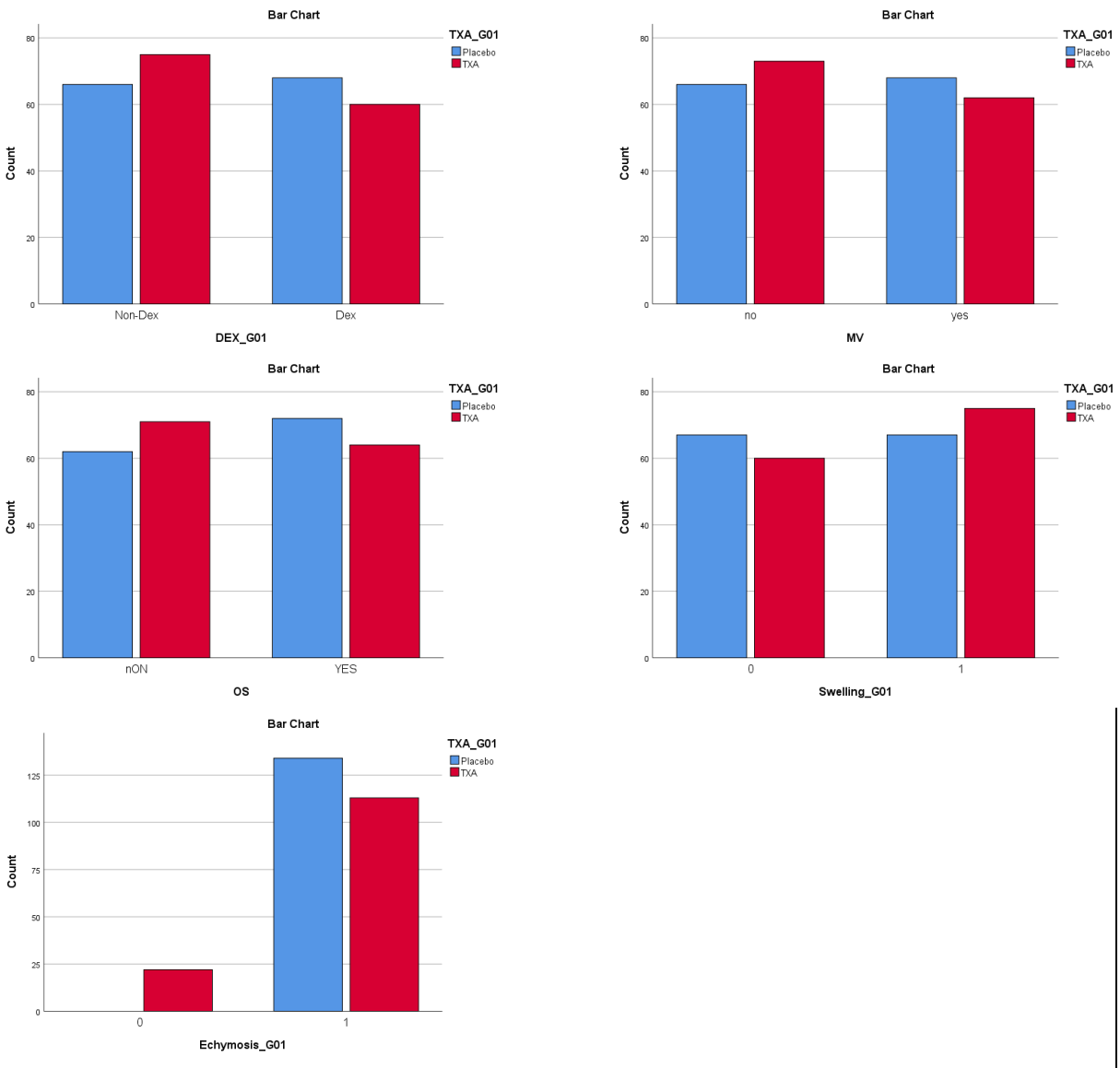
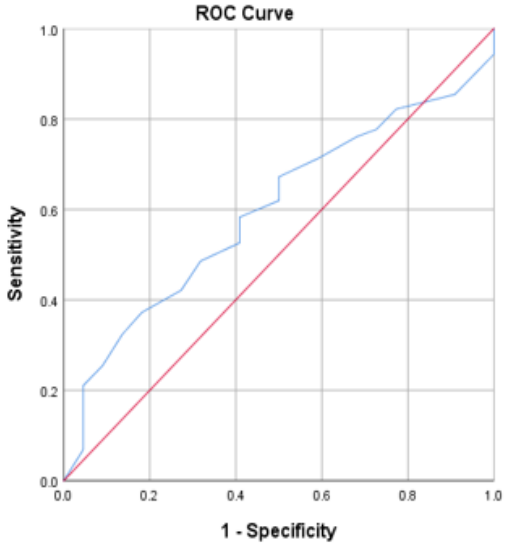


Figure 2. The bar charts illustrate the variables under study in both the non-tranexamic acid and tranexamic acid groups.

TXA: Tranexamic acid.
Dex: Dexamethasone.
Obs: Obesity statues.

MVs:Multivitamins supplement.
AACCI: Age adjusted charlson comorbidity index.
R: Pearson correlation.

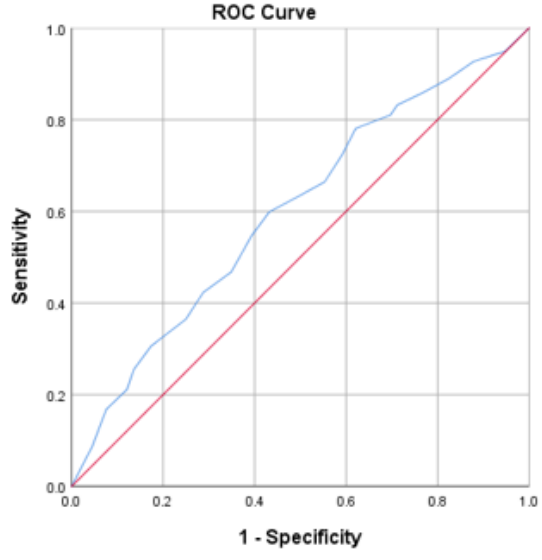


Case Processing Summary	
PRE score >2 (Positive)	247
PRE sore ≤ 2 (Negative)	22

AUROC±SEM (95% CI; LL-UL)
0.596±0.054 (95% CI; 0.489-0.702)
(P-value=0.137)

Figure 3. The receiver operating characteristic curve analysis for the studied patients' procedural duration timeframe in minutes against post-rhinoplastic ecchymosis score > 2.

PRE: Post-rhinoplastic ecchymosis **AUROC:** Area under the ROC curve
ROC: Receiver operating characteristic **SEM:** Standard error of mean.

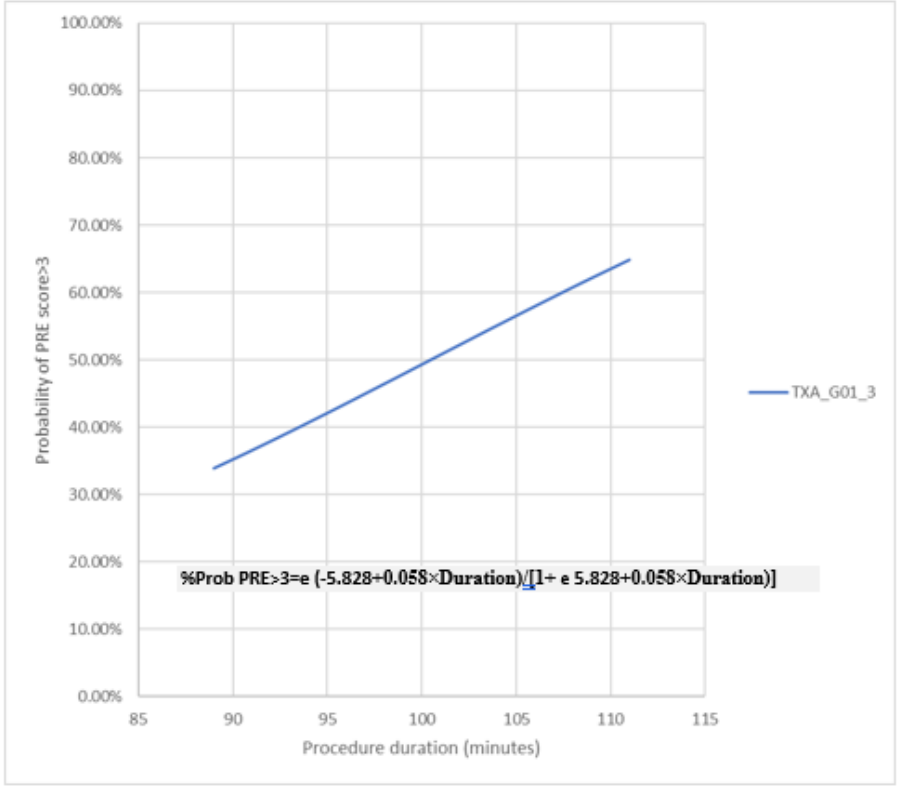


Case Processing Summary	
PRE score >3 (Positive)	137
PRE sore ≤ 3 (Negative)	132

AUROC±SEM (95% CI; LL-UL)
0.601±0.034 (95% CI; 0.533-0.668)
(P-value=0.004)

Figure 4. The receiver operating characteristic curve analysis for the studied patients' procedural duration timeframe in minutes against post-rhinoplastic ecchymosis score >3.

PRE: Post-rhinoplastic ecchymosis **AUROC:** Area under the ROC curve
ROC: Receiver operating characteristic **SEM:** Standard error of mean.

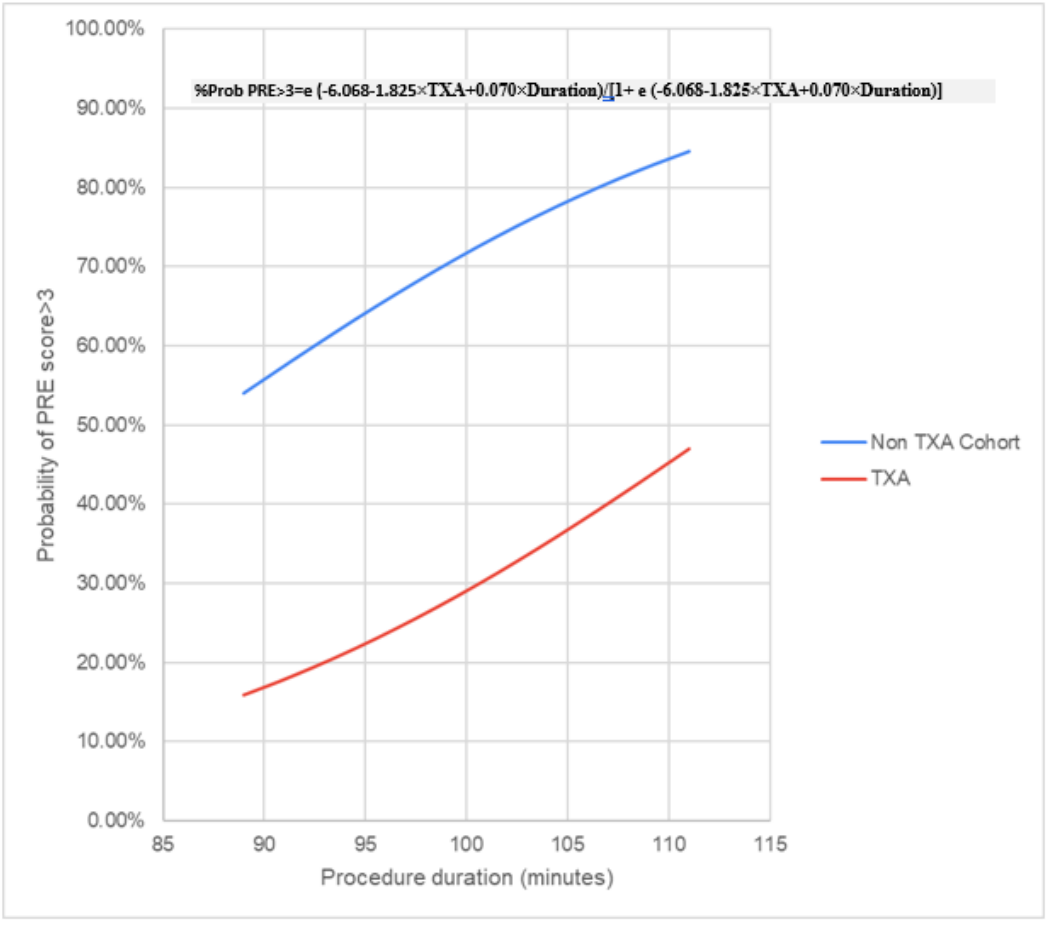


	B±S.E.	Wald	Sig.	Exp(B)	%Var	χ2 (df) p-value	TPR	TNR	PPV	NPV	AI
Duration	0.058±0.021	8.085	0.004	1.060	3%-4.1%	8.138 (8) 0.420	63.5%	50%	56.9%	56.9%	56.9%
Constant	-5.828±2.066	7.955	0.005	0.003							

Cutoff	TPR	YI	TNR	PPV	NPV	NLR	AI	%Prob
100.50	59.9%	16.67%	56.82%	58.99%	57.69%	70.66%	58.36%	50.02%

Figure 5. The binary logistic regression illustration with its accompanied overall and sensitivity indices results.

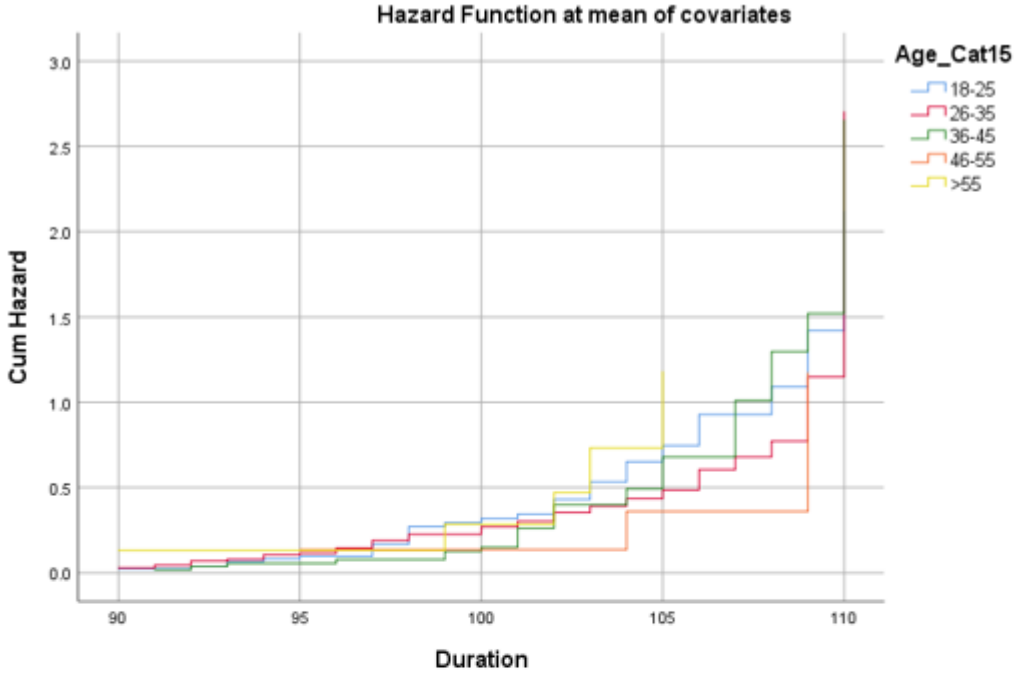
PRE: Post-rhinoplastic ecchymosis.
EXP (B): Estimate risk.
B: estimated coefficient.
%Var: Variability percentages.
%Prob: Probability percentage.
Sig: Statistically significance**.**
χ2: Chi square.
TPR: True positive rate (sensitivity).
TNR: True negative rate (specificity).
PPV: Positive predictive value.
NPV: Negative predictive value.
NLR: Negative likelihood ratio.
YI: Youden's index.
AI: Accuracy index.



	B±S.E.	Wald	Sig.	Exp(B)	%Var	χ^2 (df) p-value	TPR	TNR	PPV	NPV	AI
Duration	0.070±0.023	9.304	0.002	1.072	19.1%	3.748					
TXA (0, 1)	-1.825±0.277	43.480	0.000	0.161	to	(7)	70.1%	71.2%	71.6%	69.6%	70.6%
Constant	-6.068±2.290	7.024	0.008	0.002	25.5%	0.808					

Figure 6. The multiple logistic regression illustration with its accompanied results.

PRE: Post-rhinoplastic ecchymosis.
EXP (B): Estimate risk.
B: estimated coefficient.
%Var: Variability percentages.
%Prob: Probability percentage.
Sig: Statistically significance**.**
χ2: Chi square.
TXA: Tranexamic acid.
TPR: True positive rate (sensitivity).
TNR: True negative rate (specificity).
PPV: Positive predictive value.
NPV: Negative predictive value.
AI: Accuracy index.



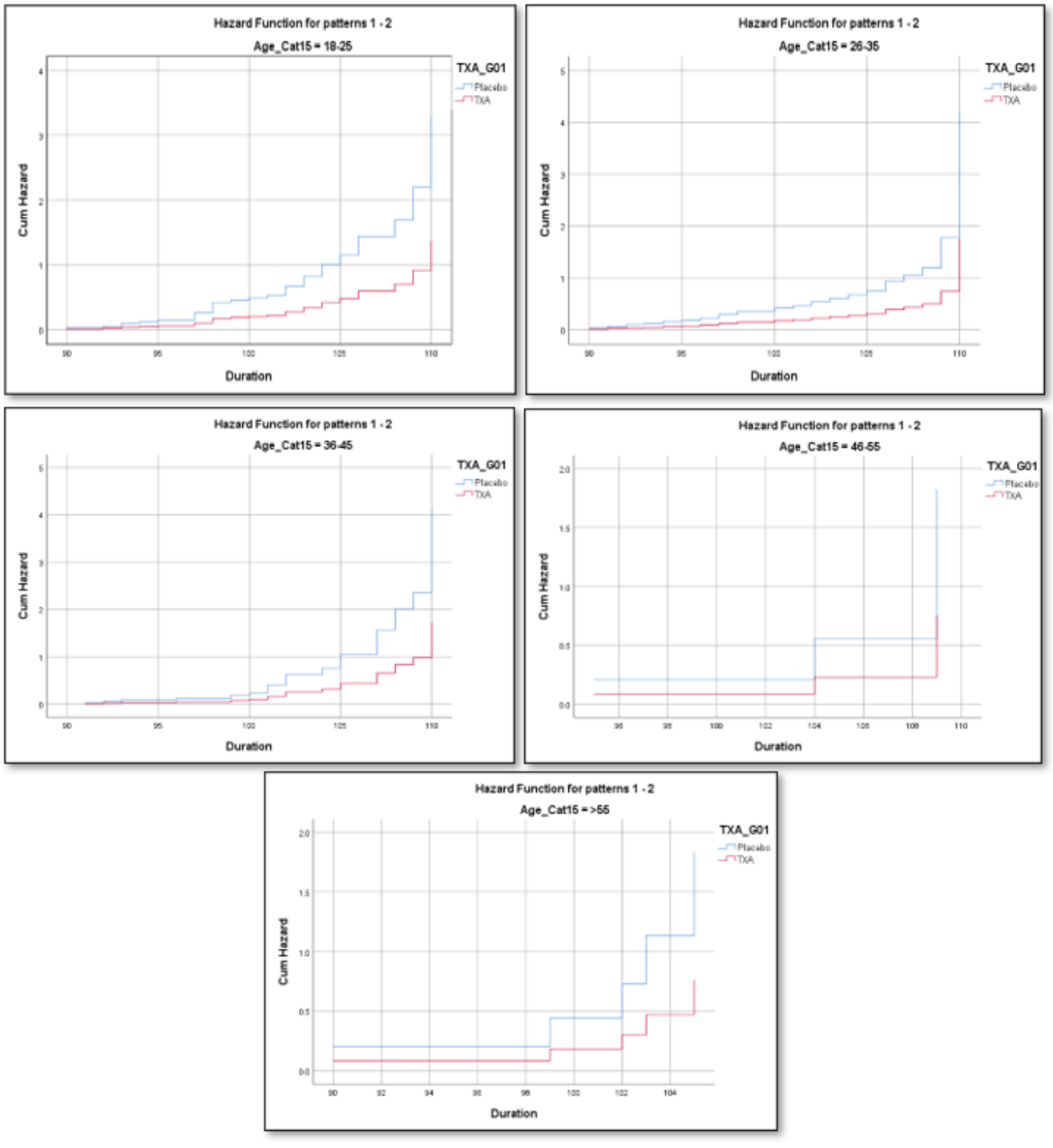
Case Processing Summary

		N (%)
Cases available in analysis	Event	137 (50.9%)
	Censored	130 (48.3%)
	Total	267 (99.3%)
Cases dropped	Censored cases before the earliest event in a stratum	2 (0.7%)
	Total	2 (0.7%)
Total		269 (100.0%)

Stratum Status

Stratum	Strata label	Event	% Event	Censored	Censored
1	18-25	39	47.60%	43	52.4%
2	26-35	59	50.40%	58	49.6%
3	36-45	28	50.90%	27	49.1%
4	46-55	5	71.40%	2	28.6%
5	>55	6	100.00%	0	0.0%
Total		137	51.30%	130	48.7%

Figure 7. Cox-regressional proportional hazard modeling results.



	B±SE	Wald	Sig.	Exp(B) (95% CI; LL-UL)	χ2 (df), Sig
TXA vs non-TXA	-0.875±0.198	19.639	0.000	0.417 (95% CI; 0.283-0.614)	(1) =21.166, 0.000

Figure 8 (continued). Cox-regressional proportional hazard modeling results.