Tranexamic Acid in Anterior Cruciate Ligament Reconstruction

Subjects: Orthopedics

Contributor: Mihail Lazar Mioc

There are several papers that investigate the use of tranexamic acid (TXA) in anterior cruciate ligament reconstructions (ACLR) or other arthroscopic procedures, that show favorable results and little to no complications. In our systematic review we show that TXA use in arthroscopic ACLR decreases postoperative blood loss and pain. Some evidence of improvement in functional scores were observed, but we believe that needs to be addressed in specific long-term result studies.

Keywords: tranexamic acid ; anterior cruciate ligament reconstruction ; postoperative pain ; knee hemarthrosis

1. Introduction

One of the most often performed arthroscopic procedures in orthopedic surgery is the anterior cruciate ligament reconstruction (ACLR) while also remaining a low-risk surgical intervention [1]. The number of such procedures is constantly growing due to the predictability of its results and the short recovery period [2][3]. Postoperative pain is usually one of the most common complaints, leading to the delay in recovery and return to activity [4]. One of the pain sources can be excessive knee swelling caused by hemarthrosis. Besides affecting recovery rate, postoperative hemarthrosis can increase infection rates and cause cartilage toxicity [5].

Tranexamic acid (TXA- $C_8H_{15}NO_2$) is a widely used pharmacological agent that prevents needless blood loss in various pathologies [6][7]. TXA acts as an antifibrinolytic agent, stabilizing blood clots and preventing fibrin degradation [8][9][10]. These usually translate into an enhanced hemostasis, decreased intraoperative bleeding and related complications [11].

2. Tranexamic Acid in Anterior Cruciate Ligament Reconstruction

The common use of TXA in arthroscopies is beginning to gain traction, after it has already become widespread in arthroplasties and trauma.

When talking about the different TXA administration protocol, we can see two main ideas: IV and IA. Out of six studies, we saw three of them having an exclusively IV protocol, and a 4th one having two intervention groups—one IV and one IA. Current literature facts indicate that most authors would prefer IV administration protocols over IA. This may be caused by the speculations that IA TXA can affect chondrocytes, as it was proven in an in-vitro study [12][13]. On the other hand, the authors showed that the cytotoxicity is related to the dosage of TXA, so further studies may be needed to determine a certain threshold that provides a sufficient benefit while not proving toxicity. Furthermore, recent studies [14] have also shown that topical use of TXA also reduces surgical blood loss and the need for blood transfusions during knee and hip arthroplasty while not increasing the risk for notable adverse events such as stroke or thromboembolism [15]. Our study failed to show a clear benefit for any one of the administration methods (IV vs. IA).

Improving the postoperative life quality through lower pain levels and better function has been the main motivation behind using TXA in ACLR. We know that pain levels may be controlled either through analgesia or decreased intraarticular pressure that may be caused by postoperative hemarthrosis. Increased hemarthrosis can cause high levels of postoperative pain, infection rates, or cartilage damage [16]. There is a consistent association between TXA patients and decreased pain levels (VAS). Other reviews and meta-analyses have also found that the intraoperative and perioperative use of TXA in arthroscopic surgery decreases hemarthrosis volumes [17][18][19]. An important point of discussion here can be developed regarding the clinical significance of the drain outputs, as negative pressure drains tend to maintain bleeding. Some may consider the hemarthrosis level to be more significant, considering that drainage would not be used.

Once low or moderate hemarthrosis occurs, the necessity for joint aspiration is paramount to reducing knee pain, joint effusion, intraarticular adhesion, and infection rates [20]. Another negative aspect of hemarthrosis is that it can cause decreased joint function and muscle strength due to a secondary deficit of rehabilitation caused by local pain.

Analyzing the results of pain levels proved much more consistent (**Table 1**). All studies used the same measurable outcome, and all of them seem to have a common follow-up trend in the 1- and 2-week check-ups. This allowed for decreased variability in outcomes and the results regarding this matter can be considered “high quality” scientific data. Studies showed a consistent decrease in pain levels of the TXA groups compared to the control groups after 1 and 2 weeks respectively, while not indicating improvement in the first 3–5 days of the postoperative period. Comparing between the two methods of TXA administration, we found no significant differences in VAS scores. When looking at longer timeframes (2–3 months follow-up), we can see that VAS levels tend to equalize between TXA and control groups, indicating that the intervention has short-term benefits.

Table 1. VAS outcome values for all included studies for all recorded follow-up.

First Author, Year	VAS Score PD 1-5		VAS Score Week 1		VAS Score Week 2		VAS Score Week 3		VAS Score 1 Mo		VAS Score 2 Mo		VAS Score 3 Mo	
	TXA	Control	TXA	Control	TXA	Control	TXA	Control	TXA	Control	TXA	Control	TXA	Control
Karaaslan, 2015	1.4 * (1 to 5)	2.9 (2 to 5)	-	-	2 * (1 to 4)	4 (2 to 5)	2 * (1 to 4)	3 (1 to 4)	-	-	-	-	-	-
Felli, 2019	2 (1.1 to 2.9)	1.8 (1 to 2.6)	0.4 (−0.3 to 1.1)	1.1 (0.1 to 2.1)	−1.7 (−2.4 to 1)	−0.1 (−1.0 to 0.8)	-	-	−1.6 (−2.5 to −0.7)	−1.1 (−1.9 to −0.3)	-	-	−2.5 (−3.5 to −1.5)	−2.4 (−3.2 to −1.6)
Chiang, 2019	3.2 *	6.7	-	-	-	-	-	-	1.7	2.0	-	-	-	-
Lee, 2020	4.2 3.3 3.0 2.9 2.0	3.3 3.1 2.6 2.3 2.1	-	-	-	-	-	-	-	-	-	-	-	-
Banca, 2021	-	-	- *	-	-	-	-	-	-	-	-	-	-	-
Ma, 2021	-	-	2.55 *	3.5	2.25 *	3.1	-	-	1.7	1.9	-	-	-	-

(-, values not reported; *, reported as statistically significant); displayed as mean value for Ma et al. for both intervention groups (IV and IA).

One thing that needs to be addressed regarding pain management is again the differences in postoperative pain management protocols. All studies have had different pain management protocols: associations of Tramadol and non-steroidal anti-inflammatory drugs (NSAIDs), Ketorolac (30 mg/8 h) for the first day and dexibuprofen (400 mg/12 h) in the next five days, Ketorolac (30 mg/8 h) for the first day and celecoxib (200 mg/12 h) for the next five days, Acupan for the first two days and acetaminophen 325 mg and tramadol hydrochloride 37.5 mg for the next three days. Having differences in the pain management protocol may influence the significance of the VAS assessments. Thus, it is advisable to account for the VAS values only as secondary outcomes for studies, as pain management standardization will be hard to achieve.

3. Conclusions

TXE use in arthroscopic ACLR decreases early postoperative blood loss and pain. This results in reduced hemarthrosis and knee aspiration incidence. Some evidence of improvement in functional scores was observed, but this needs to be addressed in specific long-term result studies. Due to insufficient evidence, it remains to be seen which one of the administration protocols (IV/IA) should be used as the standard.

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