

The Impact of Tranexamic Acid in Liver Resections: A Systematic Review

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Background: Blood loss during liver resection is an important challenge in surgery, which can have an impact on patient management. Tranexamic acid (TXA), an antifibrinolytic drug, is used broadly to minimize the bleeding in surgery. Further, the effectiveness as well as safety of this drug during hepatectomy, especially in relation to the need for blood transfusion is not very clear.

Objective: The objective of the systematic review was to assess the effect of Tranexamic acid (TXA) in improving outcomes in patients undergoing liver resection, focusing on the need for blood transfusions, blood loss, and associated complications.

Methods: A comprehensive search was conducted in PubMed, Cochrane Library and Embase databases up to December 2024. Of the 40 studies identified, after

removal of duplicates and screening for inclusion/exclusion criteria, only three met the criteria and were selected for the final review, representing a combined total of 1,892 patients.

Results: Two studies reported significant reductions in transfusion rates and blood loss with TXA, while the largest trial found no benefit. One study highlighted increased perioperative complications with TXA, underscoring safety concerns.

Conclusion: TXA shows potential in reducing transfusion needs and blood loss during liver resections, but inconsistent findings and safety concerns highlight the need for further research with standardized protocols.

Keywords: Tranexamic Acid, Liver Resection, Hepatectomy, Blood Transfusions, Perioperative Complications.

1. Introduction

The hepatectomy is a complex surgical procedure associated with significant blood loss and perioperative complications, often requiring blood transfusions. These transfusions may pose additional risks, such as infections,

immunologic reactions, and increased mortality.

The tranexamic acid (TXA), an antifibrinolytic widely used in orthopedic and cardiac surgeries, has demonstrated efficacy in reducing surgical bleeding. However, its effectiveness and safety in hepatectomies remain unclear. This

systematic review aims to synthesize the current evidence on the role of TXA in liver resection, focusing on key outcomes such as transfusion, intraoperative blood loss, and perioperative complications.

A comprehensive search was conducted in PubMed, Cochrane Library and Embase databases up to December 2024.

2. Materials and Methods

2.1. Search strategy

A comprehensive search of PubMed, Cochrane Library and Embase databases was conducted up to December 2024. Search terms included: 'Hepatectomy', "liver resection", "Tranexamic acid, "TXA", "Placebo" and "No intervention".

2.2. Eligibility criteria

Inclusion in this systematic review was restricted to studies that met all the following eligibility criteria: (1) Adult patients (≥ 18 years); (2) Patients undergoing liver resection (hepatectomy); (3) Perioperative use of tranexamic acid (TXA); (4) Intraoperative and total blood loss; (5) Need for red blood cell transfusion; and (6) Postoperative complications. We excluded studies with (1) Patient < 18 years); (2) Patients undergoing other major abdominal surgeries that are not hepatectomy; (3) Patients undergoing other major oncological surgeries that are not hepatectomy; (4) Studies that do

not include comparative results between tranexamic acid and placebo (control group); (5) Patients with contraindications to the use of tranexamic acid (e.g., history of thrombosis or severe renal failure) ; and (6) case-control, cross-sectional and case report studies.

2.3. Data Collection Process

The data collection process for this systematic review began with the identification of 40 studies collected from the PubMed, Embase, and Cochrane Library databases. Thirteen duplicate studies were removed, leaving 27 articles that were assessed by three independent reviewers by reading titles and abstracts for relevance, based on predefined inclusion and exclusion criteria.

Following this initial stage, 17 studies were excluded by reading the title and abstract for lack of relevance or not meeting the eligibility criteria. The remaining 10 articles underwent a full-text review for further evaluation. During this analysis, three studies were excluded for involving inappropriate populations, two for non-relevant interventions, and two for methodological design issues. Finally, three studies met the inclusion criteria and were included in the systematic review.

The study selection and exclusion process is presented graphically in Figure 1.

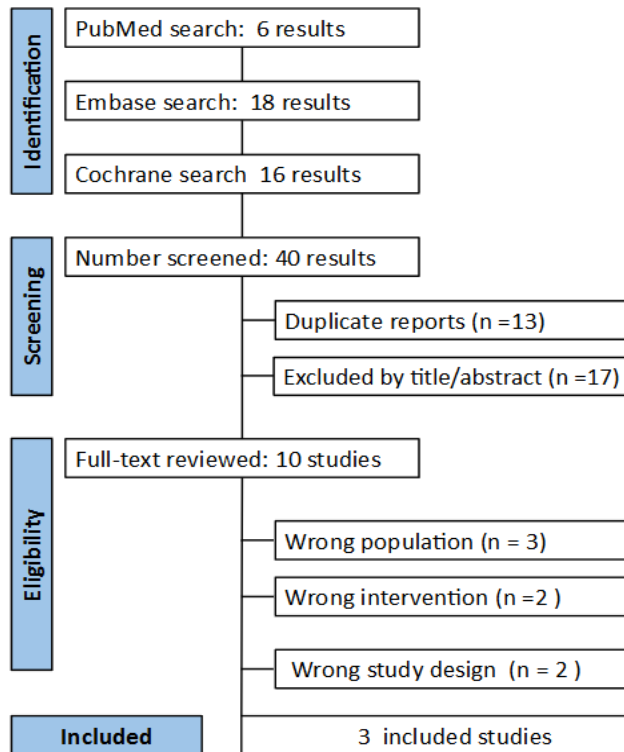


Figure 1. PRISMA flow diagram of study screening and selection

3. Result

3.1, Study Characteristics

This systematic review included a total of three studies focused on evaluating the impact of tranexamic acid (TXA) in patients undergoing hepatectomies. The studies, published between 2006 and 2024, included a multicenter randomized clinical trial, a retrospective cohort study, and a prospective double-blind trial, and were conducted in international settings including Canada, the United States, and Taiwan. A total of 1,892 patients participated, distributed between the TXA and placebo groups. As presented in Table 1.

Author	Year	Journal	Country	Type of Study	Population Size
Karanicolas et al.	2024	JAMA	Multi-national (Canada and United States)	RCT	1245
Jaffer Alisha A. et al.	2020	HPB	Canada	Retrospective cohort study	433
Cheng-Chung Wu, MD, et al.	2006	Annals of Surgery	Taiwan.	Prospective double-blind randomized trial	214

3.2. Patients' Characteristics

The demographic and clinical characteristics of the patients included in the studies are summarized in Table 2. These characteristics varied across the

included studies and may have influenced the observed outcomes. Key differences included the prevalence of cirrhosis, the proportion of major liver resections, and the baseline demographics of the populations studied.

Author	Group	Age	Female	Male	BMI	Cirrhosis
Karanicolas et al.	TXA: 619	63.1 ± 11.5	241 (38.9%)	378 (61.1%)	28.2 (6.3%)	35 (5.7%)
	Placebo: 626	63.4 ± 11.4	254 (40.6%)	372 (59.4%)	28.4 (6.3%)	26 (4.2%)
Jaffer Alisha A. et al.	TXA: 146	62 ± 11.85	58 (39.73%)	88 (60.2%)	26.6 (24.3–30.4)	0 (0%)
	Placebo: 287	64 ± 13.33	117 (40.7%)	170 (59.2%)	28.1 (24.6–31.5)	0 (0%)
Cheng-Chung Wu, MD, et al.	TXA: 108	57 ± 14	28 (25.9%)	80 (74.1%)	NR	55 (51%)
	Placebo: 106	62 ± 16.5	29 (27.4%)	77 (72.6%)	NR	55 (52%)

3.3. Key Outcomes

Studies show variability in results.

Transfusion rates: TXA significantly reduced transfusion requirements in two studies, and Wu et al. eliminated transfusions completely. However, no benefit was seen in a larger trial (Karanicolas et al.).

Blood loss intraoperative: Jaffer and Wu reported significant reductions in intraoperative blood loss, but Karanicolas found no benefit.

Complications: Only Karanicolas reported an increase in perioperative complications, emphasizing the need for careful patient selection. In the Table 3 summarizes these findings.

Table 3			
	Transfusion Rates	Intraoperative Blood Loss	Complications
Karanicolas et al.	There were no significant differences between TXA (16.3%) vs Placebo (14.5%)	No significant difference	Increased (OR 1.28, p=0.03)
Jaffer Alisha A. et al.	TXA: 20.5%; Placebo: 32.0%	Reduced significantly	No increase observed
Cheng-Chung Wu, MD, et al.	Eliminated transfusions (0% vs 16%)	Reduced significantly	No increase observed

4. Discussion

4.1. Principal Findings

TXA shows potential benefits in reducing transfusion and intraoperative blood loss in patients undergoing hepatectomy. However, the increased complications reported in one study highlights the importance of patient selection and cautious use in high-risk populations.

4.2. Limitations

One of the main limitations of this systematic review is the small number of included studies, which limits the generalizability of the findings and reduces the ability to detect consistent patterns in the results.

There is also a notable heterogeneity between the designs and results of the included studies. This variability is reflected in differences in patient characteristics and intervention protocols, such as TXA doses and administration times. These differences make direct comparisons difficult and

may influence the interpretation of the results.

4.3. Implications for Practice and Research

The variability of results highlights the need to standardize study design and dosing protocols. Although TXA appears effective in reducing transfusion requirements and blood loss, concerns about safety, particularly thrombotic complications, warrant further investigation.

Future research should focus on large-scale trials with standardized TXA administration protocols and improved reporting of complications.

5. Conclusion

TXA demonstrates potential as an effective strategy for managing blood loss in liver resections. However, its routine application requires further evidence from large-scale, standardized trials to address inconsistencies and confirm safety.

References

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