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Meta-Analysis

Surgical outcomes and complications trauma-related solid organ resections: a systematic review and meta-analysis

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ABSTRACT

Trauma-related resections of solid organs, particularly the spleen and kidneys, are often necessitated in hemodynamically unstable patients. However, these interventions are associated with significant postoperative morbidity and mortality. This systematic review and meta-analysis followed PRISMA guidelines and registered on PROSPERO (CRD42024614171). Databases were searched for studies published between 2014 and 2024. Eligible studies reported outcomes of adult trauma patients undergoing surgical resection of solid organs (spleen, kidney, liver, bladder). Data extraction included baseline characteristics, surgical details, and postoperative complications. The risk of bias was assessed using the Cochrane RoB 1.0 and Newcastle-Ottawa Scale. Meta-analyses were performed using random-effects models. Fifteen studies comprising 50,537 patients were included. Splenectomy was the most frequently performed resection, followed by nephrectomy. Infectious complications were the most common adverse events postoperatively, particularly pneumonia and sepsis following splenectomy. Hemorrhagic complications and thromboembolic events were also observed. Pooled analysis showed no significant difference in hospital length of stay between resected and control groups (SMD=0.38 days; 95% CI: –5.28 to 6.04; I^2=94%). Mortality odds were higher in the resection group (OR=1.42; 95% CI: 0.81 to 2.46), though not statistically significant (I^2=49%). Trauma-related splenectomy and nephrectomy are associated with considerable risk of infectious and hemorrhagic complications and may confer higher but statistically non-significant mortality risk. These findings underscore the importance of organ-preserving approaches in trauma care and highlight the need for vigilant postoperative management in patients undergoing emergency solid organ resections.

Keywords: Trauma, Splenectomy, Nephrectomy, Solid organ injury, Postoperative complications, Mortality, Meta-analysis, Systematic review

INTRODUCTION

Traumatic injury to solid abdominal organs, primarily the liver, spleen, and kidneys, is a significant cause of morbidity and mortality following blunt or penetrating trauma.[1,2] These injuries carry a significant risk of hemorrhage and necessitate rapid surgical interventions to stabilize patients and control bleeding. In life-threatening cases, solid organ resection becomes essential despite being linked with substantial postoperative

complications.[3,4] These risks are further exacerbated in trauma settings by the severity of the injury, underlying comorbidities, high intraoperative blood loss, and the emergent situation of intervention.

Postoperative complications ranging from surgical site infections, hemorrhage, and organ dysfunction to delayed healing, thromboembolic events, and new-onset mental disorders significantly impair outcomes.[5-7] In large cohorts of abdominal surgery patients, perioperative organ injury, e.g., acute kidney injury and acute liver injury, is strongly associated with increased in-hospital mortality and prolonged hospitalization.[8] Additionally, postoperative infectious complications alone have been demonstrated to adversely affect long-term outcomes, including survival, in surgical populations, even in controlled settings.[9]

Complex liver resections are associated with acute kidney injury in approximately 21 % of patients, significantly increasing both morbidity and mortality.[1] Splenectomy, meanwhile, is linked to elevated rates of postoperative infections, including pneumonia and urinary tract infections, as well as a higher prevalence of multiple concurrent infections compared with non-splenectomy patients.[3,6,10] High-grade liver injuries managed operatively carry operative mortality rates of up to 23.4 %, reflecting the significant severity of these interventions.[11] Despite advances in damage-control surgery, interventional radiology, and postoperative critical care, the incidence and predictors of complications following trauma-related solid organ resections are not fully defined.[12] There remains a lack of comprehensive data synthesizing the outcomes and complications across different types of organs, injury severities, and surgical approaches. This systematic review and meta-analysis aimed to fill this gap by quantifying the incidence, severity of postoperative complications, and mortality among trauma patients undergoing solid organ resections.

METHODS

Registration

This systematic review was conducted by the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines and was registered under the International Prospective Register of Systematic Reviews (PROSPERO) with the registration number CRD42024614171.[13] Data from a prior publication was used in this study; therefore, no local ethics approval was required.

Study eligibility criteria

The search encompassed retrospective studies, prospective studies, randomized clinical trials, and studies with restrictions to date on publication from 2014 to 2024. Inclusion criteria were: publication in English and focus on adult patients undergoing surgical resection for solid organ injury (kidney, liver, bladder, or spleen). Studies were excluded if they: used the improper methodology (i.e., meta-analysis/systematic review, economic analysis, narrative review, review article, editorial, case-control or case report); were published in languages other than English; involved animal, pediatric, or cadaveric subjects; or lacked sufficient methodological or outcome data. Furthermore, studies involving patients with previous conservative management were excluded. Only studies meeting all eligibility criteria were included in the final analysis.

Literature search strategy

A systematic literature search was performed through PubMed, Web of Science, Google Scholar, and ProQuest up to the 8th of December 2024 according to the preferred reporting items for systematic reviews and meta-analyses checklist (PRISMA). Combining the following combinations and terms was the search strategy: (trauma OR traumatic injury OR solid organ injury) AND (surgical resection OR resection), (trauma OR traumatic injury OR solid organ injury OR liver injury) AND (surgical resection OR hepatectomy OR resection), (trauma OR traumatic injury OR bladder injury) AND (surgical resection OR resection), (trauma OR traumatic injury OR spleen injury) AND (surgical resection OR splenectomy OR resection), (trauma OR traumatic injury OR kidney injury) AND (surgical resection OR nephrectomy OR resection).

Screening and data extraction

All identified records from the selected databases were imported into Rayyan software for deduplication and systematic screening (E.M). The screening process was conducted in three sequential phases. Initially, two independent reviewers assessed the titles and abstracts to identify potentially eligible studies (S.B and L.SH.). Subsequently, two reviewers evaluated the full-text articles (A.O. and F.A.). Any discrepancies encountered during this process were resolved through discussion with a third reviewer (L.Z). Figure 1 illustrates the PRISMA flow chart for study selection.

Data extraction was conducted using a standardized Excel sheet explicitly developed for this review. The extraction was carried out independently (I.M., S.B., L.SH., A.O., and F.A.) Extracted information included study characteristics (first author's name, year of publication, country of origin, study design, sample size), patient-related variables (mean age, gender, and comorbidities), and intervention-specific details (type of solid organ resected and surgical approach). Moreover, primary outcomes focused on the incidence and types of postoperative complications, including infection, hemorrhage, organ dysfunction, bowel obstruction, fistula formation, delayed wound healing, thromboembolic events, and chronic pain. Additional variables included transfusion requirements, ICU and hospital length of stay,

time to death if reported, and mortality data, including early mortality and overall survival.

Quality assessment

Two independent reviewers conducted the quality assessment of the included studies. In cases of disagreement, a third reviewer was consulted to reach a consensus. The Cochrane Risk of Bias tool (RoB 1.0) was employed for randomized controlled trials, while the Newcastle-Ottawa scale (NOS) was utilized for nonrandomized studies.[14,15] Studies deemed a high risk of bias based on the respective assessment tools were excluded from the analysis.

The quality assessment graph is shown in Figure 2. Most included studies demonstrated acceptable quality, whereas two were deemed low quality during the risk of bias assessment and were excluded from the final analysis.

Statistical analysis

Quantitative outcomes were expressed as means with standard deviations (SD), while dichotomous outcomes were reported as event rates. When studies reported medians and interquartile ranges instead of means and SDs, Cochrane-recommended methods were applied to derive the mean and SD.[14]

Meta-analysis was performed using a random-effects model. Standardized mean differences (SMDs) were calculated to pool and compare continuous outcomes, whereas odds ratios (ORs) were used for dichotomous data. Heterogeneity across studies was assessed using the I^2 statistic, with values >50% indicating substantial heterogeneity and >75% indicating considerable heterogeneity.[4] All analyses were conducted using the meta package in R (version 4.2.1).[16]

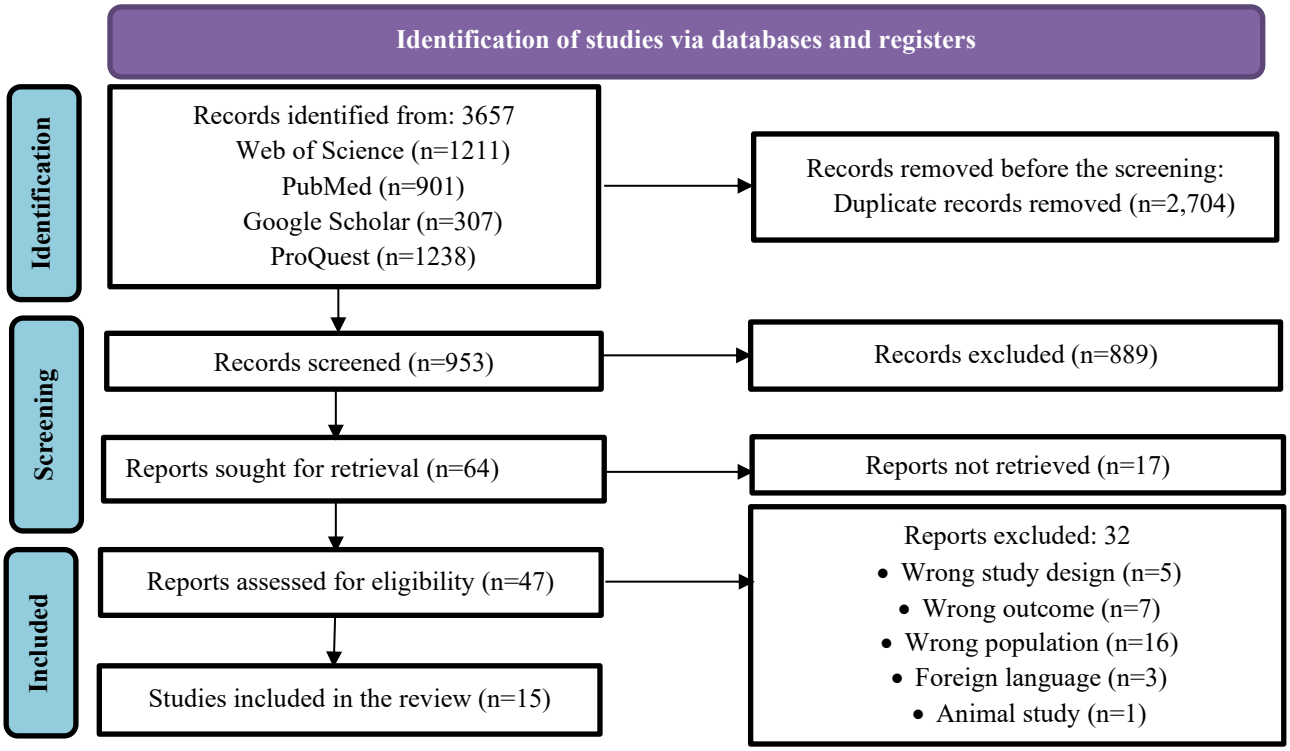

Figure 1: PRISMA flow chart for study selection.

RESULTS

Baseline and clinical characteristics

A total of fifteen studies met the inclusion criteria, representing 50,537 traumatic patients who underwent solid organ resection, primarily involving the spleen and kidneys.[17-31] Study designs included retrospective cohorts (n=14) and one randomized controlled trial. The majority of studies originated from the United States (5/15), with additional contributions from Asia (n=3) and Africa (n=2).

Sample sizes ranged widely from 16 to 25,521 participants. Table 1 highlights the baseline and clinical characteristics of the included studies. Males consistently outnumbered females across all studies; the mean age of included participants ranged widely, with several studies reporting mean ages between 31 and 57 years. The most common comorbidities among patients, when reported, included hypertension, chronic kidney disease (CKD), diabetes mellitus, and cerebrovascular disease, although most datasets lacked comprehensive reporting on these factors.

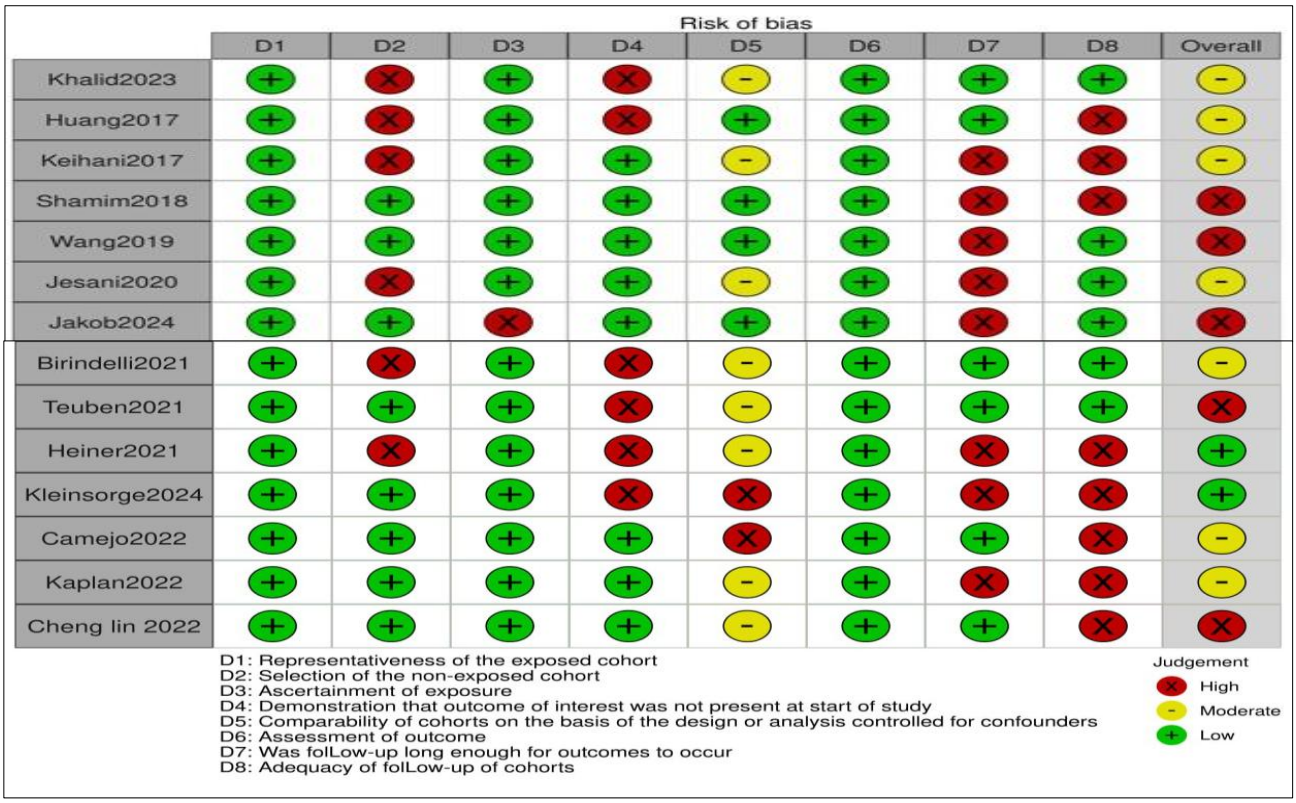

Figure 2: Quality assessment graph of the included studies.

Injury characteristics and operative approaches

The spleen was the most frequently resected organ, with 11 studies focused on splenectomy, while four studies addressed nephrectomy following renal trauma.[17-31] The majority of patients sustained high-grade injuries (AAST grade III-V), and blunt trauma was the dominant mechanism of injury, though some studies included penetrating injuries or mixed mechanisms. Operative management was most often immediate, especially in hemodynamically unstable cases, with splenectomies and nephrectomies being the most common procedures performed.

Postoperative complications

Across the extracted data, infectious complications were the most common postoperative issue, especially after splenectomy. For example, Jakob et al documented 30 cases of pneumonia and 14 of sepsis following splenic resection, while Chun-Cheng et al reported 1,917 cases of pneumonia post-splenectomy.[19,25]

Hemorrhagic complications were significant, often necessitating blood transfusion, as evidenced by several studies reporting perioperative transfusion volumes (e.g., Huang et al's mean blood loss 2,556.87 ml in splenectomy).[30] Nephrectomy was associated with acute kidney injury and prolonged hospital stay in high-risk cohorts.

Thromboembolic events were reported, with Jakob et al. reporting 8 cases of DVT and 5 of PE after splenectomy.[25] Other less common but clinically relevant complications included wound infection.17 The presence and type of complications varied depending on the organ resected, injury mechanism, and patient comorbidity profile (Table 2).

Meta-analysis of length of stay and mortality

Seven studies reported LOS, but only three provided means and standard deviations suitable for meta-analysis. The pooled standardized mean difference (SMD) for LOS between the intervention and control groups was 0.38 days (95% CI: –5.28 to 6.04), indicating no statistically significant difference (I^2=94%), as shown in Figure 3.

Seven studies reported mortality in both groups. On a single-study level, higher odds of mortality were noted in the intervention group in two of the included studies. In contrast, the remaining five studies reported no statistically significant association between mortality and either of the study groups. The overall pooled odds ratio (OR) of mortality was higher for the intervention group than the control group (OR: 1.42). However, no statistically significant association was evident (95% CI: 0.81 to 2.46). A moderate level of heterogeneity was detected (I^2: 49%) (Figure 4).

Table 1: Baseline characteristics included studies.

Study	Country	Study design	Sample size	Gender		Age (mean) (years)	Primary operation	Severity of injury	Trauma mechanism
				Female	Male				
El-Ouardi et al	Morocco	Retrospective study	119	18	110	31	Nephrectomy	III-V	Traffic accident, fall from a height, stabbing assault, work accident, sports accident
Huang et al	USA	Retrospective study	52	3	8	48.7	Splenectomy	_	Blunt
Keihani et al	India	Retrospective study	242	44	250	34	Nephrectomy	III-V	Blunt injury
Shamim et al	USA	Retrospective study	25521	7	13	39	Splenectomy	V	Blunt
Wang et al	Taiwan	Retrospective study	531	140	391	34.16	Nephrectomy		Blunt and penetrating
Jesani et al	United Kingdom	Retrospective study	53	NR	NR	Median: 45	Splenectomy	I-V	Blunt
Jakob et al	Switzerland	Retrospective study	400	96	304	Median: 31	Open splenectomy	III-V	Blunt and penetrating
Heiner et al	USA	Retrospective study	128	27	101	_	Nephrectomy	III-V	Penetrating
Habeeb et al	Egypt	Prospective randomized clinical trial	35	10	25	34.58±10.58	Open splenectomy	III-IV	Blunt
			35	7	28	33.41±11.02	Laparoscopic splenectomy	III-IV	Blunt
Birindelli et al	Italy	Retrospective study	48	10	22	50	Open splenectomy	III-IV	Blunt
				3	13	80	Laparoscopic splenectomy	III-IV	Blunt
Teuben et al	Netherlands	Retrospective study	18	6	12	38	Splenectomy	ISS: 29	Blunt
Kleinsorge et al	Brazil	Retrospective study	84	NR	NR	36 ± 15.6	Splenectomy	III, IV	Blunt
Camejo et al	USA	Retrospective study	35	9	26	50	Open splenectomy	Splenic injury grade (I-V)	Blunt and penetrating
Kaplan et al	USA	Retrospective study	11419	3276	8143	41.9	Splenectomy	ISS mean 30.96	Blunt and penetrating
Chun-Cheng et al	Taiwan	Retrospective study	11817	5228	6589	57.39 ± 15.01	Splenectomy	NR	Blunt

Table 2: Postoperative complication.

Study	Primary operation	Infection	Hemorrhage	shock	Organ dysfunction	Bowel obstruction	Fistula formation	Delayed healing	Thromboembolic events	Chronic pain	Transfusion
El-Ouardi et al	Nephrectomy	-	-	-	-	-	-	-	-	-	
Huang et al	Splenectomy	-	2556.87 ml	-	-	1	-	-	-	-	
Keihani et al	Nephrectomy	-	-	-	-	-	-	-	-	-	
Shamim et al	Splenectomy	-	7	3	-	-	-	-	-	-	
Wang et al	Nephrectomy	Sepsis: 20	-	-	11	-	-	-	-	-	
Jesani et al	Splenectomy	-	-	-	-	-	-	-	-	-	
Jakob et al	Splenectomy	Pneumonia: 30, sepsis: 14	-	-	-	-	-	-	DVT: 8 and PE: 5	-	
Heiner et al	Nephrectomy	-	-	-	-	-	-	-	-	-	
Habeeb et al	Open Splenectomy	15	-	-	-	8	4	-	-	-	28
	Laparoscopic Splenectomy	2	-	-	-	0	1	-	-	-	20
Birindelli et al	Open Splenectomy	7	-	-	-	-	-	-	-	-	24
	Laparoscopic Splenectomy	0	-	-	-	-	-	-	-	-	13
Teuben et al	Splenectomy	-	-	-	-	-	-	-	-	-	-
Kleinsorge et al	Laparotomy	-	-	257	-	-	-	-	-	-	-
Camejo et al	Splenectomy	16	NR	NR	NR	NR	NR	NR	NR	NR	They received a total transfusion of 368 ml
Kaplan et al	Open splenectomy	Surgical wound infection	-	Septic shock	-	-	-	-	1	-	-
Chun-Cheng et al	Splenectomy	-	-	-	-	-	-	-	-	-	-
El-Ouardi et al	Splenectomy	1917 (pneumonia)	-	-	-	-	-	-	-	-	-

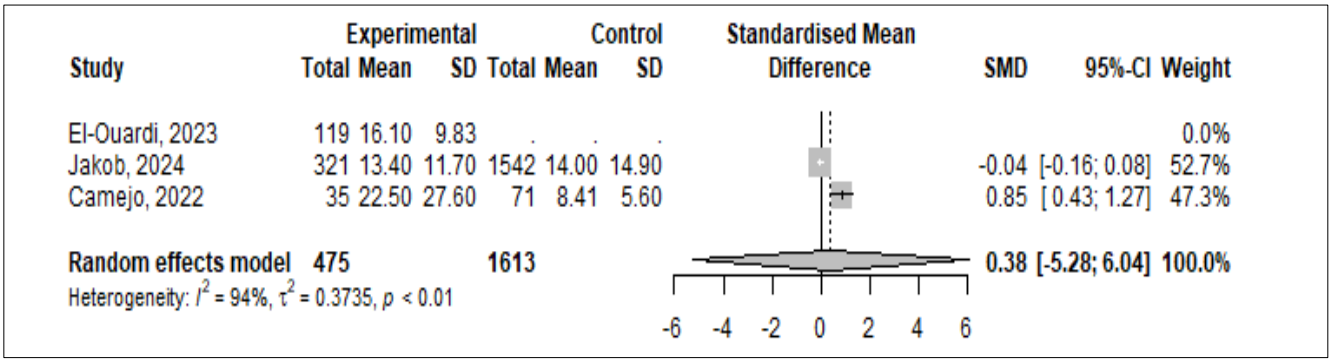

Figure 3: Forest plot comparing pooled LOS between intervention and control groups.

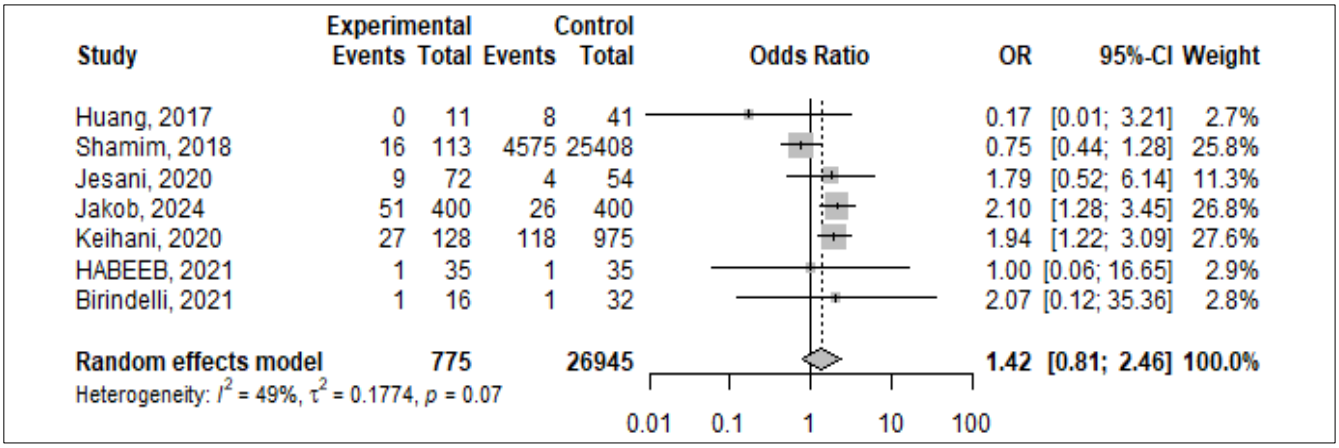

Figure 4: Forest plot comparing pooled mortality or between intervention and control groups.

DISCUSSION

This systematic review and meta-analysis aimed to address the existing gaps in understanding the postoperative outcomes associated with trauma-related solid organ resections, an area of significant clinical importance due to the high morbidity and mortality linked to these injuries. Improved trauma care and the widespread adoption of nonoperative management have reduced the frequency of emergency organ resection, yet it remains a lifesaving intervention in unstable patients.[32]

Our review demonstrates that trauma-related splenectomy and nephrectomy are associated with substantial morbidity and mortality. Infectious complications emerged as the most prevalent in the sample studied, ranging from surgical site infections and pneumonia to sepsis and intra-abdominal abscesses. This finding is consistent with the notion that splenectomy predisposes patients to severe infections. Indeed, prior multicenter research by Demetriades et al found the incidence of early infectious complications to be significantly higher in trauma patients who underwent splenectomy (32.0%) compared to those managed nonoperatively or with splenic salvage (approximately 5% or less).[33]

In this prospective study, splenectomy patients had notably higher rates of pneumonia, intra-abdominal abscess, and septicemia compared to patients whose spleens were preserved.[33] The literature strongly supports the marked predisposition to infection after splenectomy observed in our analysis. Beyond the classical long-term overwhelming post-splenectomy infection risk, there is clear evidence that early postoperative infections are significantly more common after splenectomy.

Our findings concur that splenectomy patients are highly vulnerable to infectious morbidity, with sepsis and respiratory infections accounting for many complications. In contrast, high rates of post-splenectomy immunization and antibiotic prophylaxis have been associated with a low incidence of fulminant infections in long-term follow-up. In the series by Davies et al, no cases of overwhelming post-splenectomy infection were observed over 18 years of follow-up, likely owing to vigilant vaccination and prophylactic antibiotics in their practice.[32]

Furthermore, hemorrhagic complications defined as significant postoperative bleeding often requiring re-operation were relatively infrequent in our pooled data. However, when post-splenectomy hemorrhage did occur, it was often catastrophic: one large series reported a 21% mortality rate among patients who required re-operation for intraperitoneal hemorrhage versus <1% mortality in

those without hemorrhage.[34] This underscores that while proactive surgical control of bleeding saves lives in trauma, continued vigilance for and prompt management of any re-bleeding is critical to prevent fatal outcomes.

Qu et al documented an incidence of approximately 1-3% for intraperitoneal hemorrhage after splenectomy.[34] They also highlighted the grave consequences of this complication: delays in recognizing post-splenectomy bleeding were associated with a mortality of over 20%.[34] Our analysis reinforces that while relatively uncommon, hemorrhagic complications remain a critical concern.

These results both reflect and extend the findings of prior trauma studies. The high overall complication rates observed are in line with reports that trauma laparotomy patients are often among the most severely injured and thus incur significant postoperative morbidity. For instance, one single-center study of emergency splenectomy reported operative morbidity of 13.5% and mortality of 21.6% for trauma patients.[32] Extensive registry analyses indicate that patients undergoing trauma nephrectomy have significantly higher mortality than those managed conservatively, with in-hospital mortality being 16.6% in patients who underwent nephrectomies versus 5.7% in nonoperative cases in one National Trauma Data Bank study.[35]

The significant morbidity and mortality identified in this review underscore the importance of strategies to reduce the need for and the impact of trauma-related organ resections. Our findings support current trauma practice guidelines that advocate for organ-preserving approaches whenever clinically feasible. Future research should focus on refining patient selection and improving adjunct therapies for these cases. Prospective studies or extensive registry analyses could help identify predictors for organ resection versus nonoperative measures. Moreover, long-term follow-up of trauma survivors who underwent organ resections. While our review concentrated on in-hospital outcomes, the long-term outcomes remain areas to be investigated in a setting of trauma cohorts.

This review has several limitations. First, the analysis is limited by the quality and heterogeneity of the underlying studies. Most of the 15 included studies were retrospective observational series, subject to selection biases and variability in data reporting. Second, there was considerable heterogeneity in how complications were defined and reported across studies. Some authors reported only major complications, whereas others included minor events, making direct comparisons and pooled estimates less precise. We attempted to account for this by focusing on clearly defined outcomes (infections, hemorrhage requiring intervention, acute kidney injury), but differences in definition likely introduced variability. Third, the patient populations varied; included studies spanned different eras of trauma care and mixed mechanisms of injury (blunt versus penetrating trauma). Fifth, we combined outcomes for splenectomy and nephrectomy, assuming common risk patterns in "solid organ resections," our combined analysis may obscure differences between splenectomy and nephrectomy outcomes. These limitations suggest that our quantitative estimates should be interpreted with caution.

In conclusion, this study provides a comprehensive overview of the acute outcomes after trauma-related spleen and kidney resections. The evidence confirms that, despite being often lifesaving, these surgeries come at a high price in terms of complications. By recognizing the patterns of morbidity outlined here, trauma teams can better anticipate and counteract these issues. The ultimate goal should be to improve trauma care such that emergency organ resection is required only in essential circumstances. When it is, we optimize perioperative management to ensure patients survive and recover with the least possible long-term deficit.

CONCLUSION

Trauma-related splenectomy and nephrectomy are associated with significant postoperative complications and mortality. Our systematic review and meta-analysis found that infectious complications (such as pneumonia, intra-abdominal abscess, and sepsis) are prevalent after emergency splenectomy, reflecting the loss of splenic immune function and the critical illness of these patients. Although postoperative hemorrhage requiring re-operation is relatively uncommon, it remains a life-threatening complication when it occurs. These findings reinforce the importance of pursuing organ-preserving trauma management whenever feasible and of employing careful postoperative care when splenectomy or nephrectomy is unavoidable.

By adopting strategies to prevent infections, support renal function, and rapidly control bleeding, clinicians can improve outcomes for this high-risk population. Ultimately, continued advances in both surgical technique and nonoperative interventions are needed to reduce the necessity for organ resection and to enhance survival and recovery for trauma patients with solid organ injuries.

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REFERENCES

1. Sawhney C, Kaur M, Gupta B, Singh PM, Gupta A, Kumar S, et al. Critical care issues in solid organ injury: Review and experience in a tertiary trauma center. Saudi J Anaesth. 2014;8(Suppl 1):S29-35.
2. Johnsen NV, Betzold RD, Guillamondegui OD, Dennis BM, Stassen NA, Bhullar I, et al. Surgical Management of Solid Organ Injuries. Surg Clin North Am. 2017;97(5):1077-105.
3. Camejo L, Nandeesha N, Phan K, Chharath K, Tran T, Ciesla D, et al. Infectious outcomes after

splenectomy for trauma, splenectomy for disease and splenectomy with distal pancreatectomy. Langenbecks Arch Surg. 2022;407(4):1685-91.
4. Kagoura M, Monden K, Sadamori H, Hioki M, Ohno S, Takakura N. Outcomes and management of delayed complication after severe blunt liver injury. BMC Surg. 2022;22(1):241.
5. Malhotra AK, Latifi R, Fabian TC, Ivatury RR, Dhage S, Bee TK, et al. Multiplicity of solid organ injury: influence on management and outcomes after blunt abdominal trauma. J Trauma. 2003;54(5):925-9.
6. Chalya PL, Mabula JB, Giiti G, Chandika AB, Dass RM, McHembe MD, et al. Splenic injuries at Bugando Medical Centre in northwestern Tanzania: a tertiary hospital experience. BMC Res Notes. 2012;5:59.
7. Tan KK, Chiu MT, Vijayan A. Management of Isolated Splenic Injuries after Blunt Trauma: An Institution's Experience Over 6 Years. Med J Malaysia. 2010;65:308433.
8. Kork F, Liang Y, Ginde AA, Yuan X, Rossaint R, Liu H, et al. Impact of perioperative organ injury on morbidity and mortality in 28 million surgical patients. Nat Commun. 2025;16(1):3366.
9. Chen Q, Deng Y, Chen J, Zhao J, Bi X, Zhou J, et al. Impact of Postoperative Infectious Complications on Long-Term Outcomes for Patients Undergoing Simultaneous Resection for Colorectal Cancer Liver Metastases: A Propensity Score Matching Analysis. Front Oncol. 2022;11:793653.
10. Fransvea P, Costa G, Serao A, Cortese F, Balducci G, Sganga G, et al. Laparoscopic splenectomy after trauma: Who, when and how. A systematic review. J Minim Access Surg. 2021;17(2):141-6.
11. Ramos-Jimenez RG, Deeb AP, Truong EI, Newhouse D, Narayanan S, Alarcon L, et al. High-grade liver injury: outcomes with a trauma surgery-liver surgery collaborative approach. Trauma Surg Acute Care Open. 2025;10(1):e001611.
12. El-Menyar A, Abdelrahman H, Al-Hassani A, Peralta R, AbdelAziz H, Latifi R, et al. Single Versus Multiple Solid Organ Injuries Following Blunt Abdominal Trauma. World J Surg. 2017;41:2689-96.
13. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;372:n71.
14. Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Matthew J. Cochrane Handbook for Systematic Reviews of Interventions Second Edition. 2019.
15. Wells G, Shea B, O'Connell D, Robertson J, Peterson J, Welch V, et al. The Newcastle-Ottawa Scale (NOS) for Assessing the Quality of Nonrandomized Studies in Meta-Analysis. 2011. Available at: https://www.evidencebasedpublichealth.de/download/Newcastle_Ottowa_Scale_Pope_Bruce.pdf. Accessed on 10 October 2025.
16. Balduzzi S, Rücker G, Schwarzer G. How to perform a meta-analysis with R: a practical tutorial. Evid Based Ment Health. 2019;22:153-60.
17. Camejo L, Nandeesha N, Phan K, Chharath K, Tran T, Ciesla D, et al. Infectious outcomes after splenectomy for trauma, splenectomy for disease and splenectomy with distal pancreatectomy. Langenbecks Arch Surg. 2022;407:1685.
18. Kaplan HJ, Leitman IM. Race and insurance status outcome disparities following splenectomy in trauma patients are reduced in larger hospitals. A cross-sectional study. Annals Med Surg. 2022;77:103516.
19. Lin CC, Hsu SD, Chien WC, Chung CH, Chen CJ, Liang CM, et al. Comparison of Long-Term Pneumonia Risk between Spleen Injury and Non-Spleen Injury after Total Splenectomy-A Population-Based Study. J Pers Med. 2022;12(2):308.
20. Kleinsorge G, Lago R do, Pinto D. Splenectomy is Associated With More Complications Than Spleen Preservation in Patients With Blunt Abdominal Trauma. J Vasc Surg. 2024;79:56S-7S.
21. Teuben MPJ, Hollman A, Blokhuis T, Pfeifer R, Spijkerman R, Teuber H, et al. Splenectomy is associated with altered leukocyte kinetics after severe trauma. Eur J Med Res. 2021;26:26.
22. Birindelli A, Martin M, Khan M, Gallo G, Segalini E, Gori A, et al. Laparoscopic splenectomy as a definitive management option for high-grade traumatic splenic injury when non operative management is not feasible or failed: a 5-year experience from a level one trauma center with minimally invasive surgery expertise. Updates Surg. 2021;73(4):1515-31.
23. Habeeb TA, Osman G, Ibrahim A, Riad M, Metwalli A, Mansour M, et al. Myth And Facts About The Evolving Role of Laparoscopic Splenectomy In Isolated High Grades Splenic Injuries In Hemodynamically Stable Patients With Blunt Abdominal Trauma. Randomized Controlled Trial. Res Square. 2021;8.
24. Heiner SM, Keihani S, McCormick BJ, Fang E, Hagedorn JC, Voelzke B, et al. Nephrectomy After High-Grade Renal Trauma is Associated With Higher Mortality: Results From the Multi-Institutional Genitourinary Trauma Study (MiGUTS). Urology. 2021;157:246-52.
25. Jakob DA, Müller M, Kolitsas A, Exadaktylos AK, Demetriades D. Surgical Repair vs Splenectomy in Patients With Severe Traumatic Spleen Injuries. JAMA Netw Open. 2024;7(8):e2425300.
26. Jesani H, Jesani L, Rangaraj A, Rasheed A. Splenic trauma, the way forward in reducing splenectomy: our 15-year experience. Ann R Coll Surg Engl. 2020;102(4):263-70.
27. Wang SY, Lin KJ, Chen SW, Cheng CT, Chang CH, Wu YT, et al. Long-term renal outcomes in patients with traumatic renal injury after nephrectomy: A nationwide cohort study. Int J Surg. 2019;65:140-6.

28. Shamim AA, Zafar SN, Nizam W, Zeineddin A, Ortega G, Fullum TM, et al. Laparoscopic Splenectomy for Trauma. JSLS. 2018;22(4):e2018.
29. Heiner SM, Keihani S, McCormick BJ, Fang E, Hagedorn JC, Voelzke B, et al. Nephrectomy After High-Grade Renal Trauma is Associated With Higher Mortality: Results From the Multi-Institutional Genitourinary Trauma Study (MiGUTS). Urology. 2021;157:246-52.
30. Huang GS, Chance EA, Hileman BM, Emerick ES, Gianetti EA. Laparoscopic Splenectomy in Hemodynamically Stable Blunt Trauma. JSLS. 2017;21(2):e2017.
31. Khalid E, Othmane M, Amine LM, Zakaria D, Said MM, Ismail S. Predictors of nephrectomy in high-grade renal trauma patients treated primarily with conservative intent. Arch Urol Res. 2024;8:001-4.
32. Davies ILL, Cho J, Lewis MH. Splenectomy results from an 18-year single centre experience. Ann R Coll Surg Engl. 2014;96:147.
33. Demetriades D, Scalea TM, Degiannis E, Barmparas G, Konstantinidis A, Massahis J, et al. Blunt splenic trauma: splenectomy increases early infectious complications: a prospective multicenter study. J Trauma Acute Care Surg. 2012;72(1):229-34.
34. Qu Y, Ren S, Li C, Qian S, Liu P. Management of postoperative complications following splenectomy. Int Surg. 2013;98(1):55-60.
35. Anderson RE, Keihani S, Das R. Nephrectomy is Associated with Increased Mortality after Renal Trauma: An Analysis of the National Trauma Data Bank from 2007-2016. J Urol. 2021;205:841-6.

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