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Systematic review

Non-operative management of low-grade (grade I–II) splenic injury in hemodynamically stable adults

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Abstract

Blunt splenic injury (BSI) commonly managed without surgery in hemodynamically stable (HDS) patients. This systematic review aimed to evaluate the outcomes of non-operative management (NOM) in adults with grade I–II BSI. A literature search was conducted in PubMed, Scopus, Web of Science, and Embase using search terms related to splenic trauma, blunt splenic injury, conservative treatment, observation, and NOM. Original studies which include adults with low-grade splenic injury managed non-operatively were eligible. We extract data on study design, patient characteristics, management approach, success or failure of NOM, delayed intervention, complications, transfusion requirement, and hospital stay, then this extracted data was synthesized narratively.

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Eight studies published between 1989 and 2024 were included. The findings showed a high success rate of NOM in HDS adults with grade I–II injury. Failure in low-grade injury was rare and occurred usually early after admission. Failure was associated with worsening hemodynamic condition, higher transfusion need, increasing abdominal signs, and greater trauma burden. Patients with contrast extravasation represented a higher-risk subgroup, with one study showing a 20% failure rate. We conclude that NOM is effective for low-grade BSI in stable adults, and careful monitoring is important, when vascular blush or early clinical deterioration is present.

Keywords: blunt splenic injury; non-operative management; hemodynamically stable adults; low-grade splenic injury; contrast extravasation

Introduction

Blunt splenic injury (BSI) is one of the most common solid organ injuries following abdominal trauma. Preservation of the spleen become an important goal because of its major role in immune function and protection against severe infection [1–3]. For many years splenectomy was the usual treatment for BSI, and this approach changed gradually after better understanding of the spleen's immunologic value and improvements in computed tomography and critical care monitoring made conservative treatment more common [1,2].

Recent trauma literature supports non-operative management (NOM) as the standard approach in hemodynamically stable (HDS) patients, while hemodynamic instability still the main indication for operative intervention [2,4,5]. This conservative strategy includes close clinical observation with splenic artery embolization, depending on injury severity and the presence of vascular findings on imaging [3,5].

The American Association for the Surgery of Trauma grading system, widely used to classify splenic injury severity, and grades I and II are considered low-grade injuries, while grades IV and V are high-grade injuries [2]. Recent data show that the effectiveness of NOM decreases as splenic injury grade rises, with reported failure rates of only 2% to 10% for grades I and II, compared with higher failure rates in grades selection is still necessary because not all stables patient has the same risk profile [2,5].

Selection factors include hemodynamic stability, absence of peritonitis, lower transfusion need, lower injury burden, and fewer associated injuries, while higher injury grade and larger hemoperitoneum are linked with greater risk of failure [2,4,6]. Controversies remain in the follow-up and practical management of BSI, including the exact role of embolization, the timing of mobilization, follow-up imaging, and how to identify patients who look stable at first but later deteriorate [3,5,7].

Managing low-grade injuries with contrast extravasation (CE) is controversial because treatment is more complex than for uncomplicated cases [8,9]. Grade I–II splenic injuries with CE have a 20% non-operative failure rate, indicating a need for closer monitoring or earlier intervention [8].

While NOM is the standard for stable BSI, data still mixed because previous studies aggregated all injury grades or focused on high-grade cases rather than isolated low-grade adult populations [1,2,5]. Our systematic review focuses on NOM of low-grade grade I–II BSI in HDS adults, to summarize the available original articles on success, failure, complications, and the clinical factors that affect NOM in this group [1,5,8].

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Methodology

This systematic review was conducted to evaluate the outcomes of NOM in HDS adults with low-grade BSI after abdominal trauma. The review question was developed using the PICO framework. Our study population included adult patients with grade I–II BSI after blunt trauma. The intervention of interest was NOM, including clinical observation with or without supportive inpatient monitoring. The outcomes were success or failure of NOM, need for delayed intervention, complications, mortality, blood transfusion requirement, and LOS.

The literature search was performed in electronic databases (PubMed, Scopus, Web of Science, and Embase). The search was conducted using a combination of controlled vocabulary terms and free-text keywords related to splenic injury and conservative treatment. The main search concepts included terms; “splenic injury,” “splenic trauma,” “blunt splenic trauma,” “BSI,” “NOM,” “conservative management,” “observation,” “hemodynamically stable,” and “adult.” Boolean operators (AND and OR) were used to combine the search terms. The search strategy was adjusted according to the requirements of each database. The reference lists of the included articles were checked manually to identify relevant studies that have not been captured in the primary database search. Data selection process presented in (Fig 1).

Eligible studies were original research articles; adult patients aged 18 years or older; BSI; low-grade splenic injury defined as grade I or grade II; HDS patients or patients stabilized after initial resuscitation; and studies that reported data on NOM outcomes. Retrospective and prospective cohort studies were eligible for inclusion. Studies were excluded if they included pediatric patients only, penetrating trauma, mixed solid organ injury data without separate splenic results, high-grade splenic injury without extractable low-grade subgroup data, immediate operative management only, reviews, meta-analyses, editorials, conference abstracts without full data, or duplicated articles.

All records identified from the electronic databases imported into Mendeley software, and duplicate records were removed before screening. Titles and abstracts were screened first to remove clearly irrelevant studies. The full texts of eligible studies were then reviewed according to the predefined inclusion and exclusion criteria. Studies that did not report adult low-grade splenic injuries or provide usable data on NOM were excluded at the full-text stage. The final included studies were those judged to be relevant to the review question or provided extractable subgroup data for grade I–II splenic injuries.

Data extraction was performed using a standardized data extraction sheet prepared before the review process. The extracted variables included first author, year of publication, country, study design, study period, sample size, patient age, injury grading system, hemodynamic status, NOM protocol, use of angiography or embolization, success and failure rates of NOM, need for delayed surgery, complications, transfusion requirements, mortality, and LOS. When studies included mixed grades of splenic injury, only the data related to grade I–II injuries were extracted.

The findings were synthesized qualitatively as the included studies showed variation in study design, patient selection, injury grading, and outcome reporting. The results were summarized in tables and organized according to study characteristics and outcomes. Special attention was given to rates

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of successful NOM in grade I–II splenic injuries, predictors of failure, timing of delayed intervention, and the effect of CE.

Result

We include 8 original studies published between 1989 and 2024 to evaluate NOM for BSI in adults. Two studies were multicenter, while the others were single-center series. Most studies included HDS or stabilized adults, and some broader cohorts contained higher-grade injuries. According to the included studies we found that low-grade splenic injuries had a high likelihood of successful NOM in stable adults. In a CT-based series, 25 patients had grade I or II injury, and 20 of them were treated successfully without surgery, while 5 required delayed surgery. In the large multicenter adult cohort, the failure rate of planned NOM increased with injury grade, but it remained low in grade I and II injuries at 4.8% and 9.5%, respectively. The same study found that the ultimate success of NOM was 75.0% and 70.0% in grade I and grade II injuries respectively. In another study of 158 stable patients managed with NOM, success reached 100% for grade I and 96.3% for grade II injuries, with an overall non-operative success rate of 88.0% [10–12]. Characteristics of the included studies presented in Table 1.

Several studies showed that failure in low-grade injury was uncommon and occurred early after admission. In the broader trauma registry analysis, almost all failed cases in grade I and II injuries occurred within the first 24 hours. Another selected adult series reported that 5 of 60 initially observed patients failed NOM, and the main triggers for delayed surgery were blood loss more than four units, enlarging splenic defect, and increasing peritoneal signs. Additional predictors related to NOM failure in broader adult cohorts included lower systolic blood pressure, blood transfusion requirement, higher injury severity, and more extensive extra-abdominal injury [4,12–14].

Regarding the subgroup with CE in one single-center study of low-grade injuries up to grade III, 18 patients with blush were managed by NOM and 22 underwent angioembolization, and NOM had a 94.4% success rate without worse outcomes than patients without CE. The largest multicenter study focused specifically on grade I–II injuries with CE found a 20.0% combined failure rate, with similar failure rates in grade I and grade II injuries at 18.2% and 21.1%, respectively. Patients who failed NOM in that study required more blood and massive transfusion, and had increase length of hospital stay (LOS). Delayed complications were clinically important in the wider adult NOM studies, as 8% of non-operatively managed patients in one study developed delayed complications after 48 hours, including delayed bleeding, pseudoaneurysm-related bleeding, and splenic abscess [8,15,16]. Main findings of the included studies presented in Table 2.

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Fig 1: PRISMA flow chart

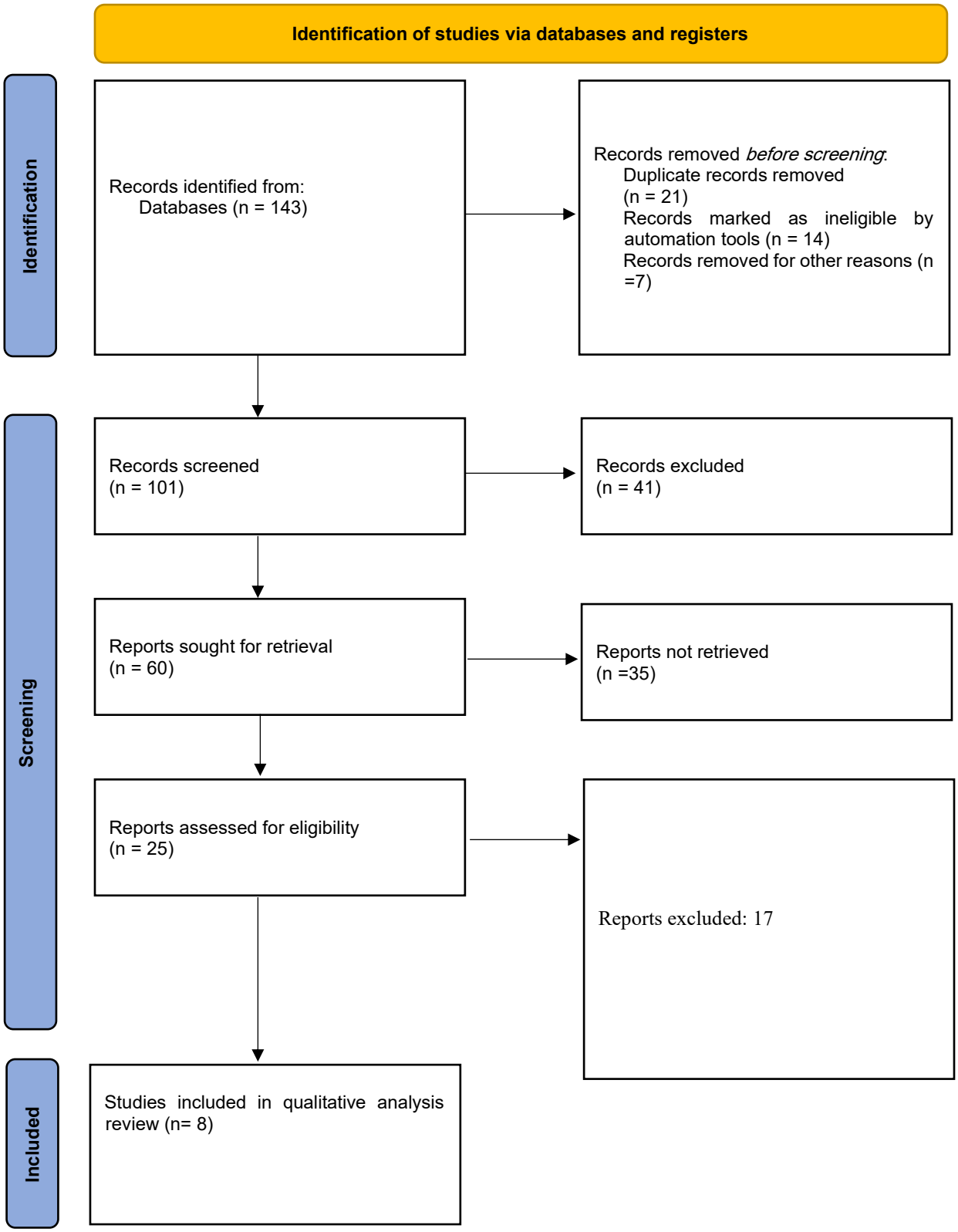

Table 1. Study characteristics and eligibility screening

Study	Setting	Design and study period	Study population
Longo et al., 1989 [13]	Yale New-Haven Hospital, USA	Retrospective study, 1980–1988	Adults aged ≥16 years with documented blunt splenic injuries; 60 of 252 were initially managed with NOM
Becker et al., 1994 [10]	University of Berne, Switzerland	Retrospective CT-based study, Oct 1986–Feb 1993	45 adults with BSI; all were HDS or resuscitated without difficulty at CT
Cocanour et al., 1998 [16]	Hermann Hospital, Houston, USA	Retrospective record, Jan 1993–Dec 1996	280 adults with BSI; 87 NOM
Peitzman et al., 2000 [11]	27 trauma centers, multicenter USA	Multicenter retrospective study; detailed cohort from 1997	1,488 adults aged >15 years with BSI
Jeremitsky et al., 2011 [14]	Allegheny General Hospital, USA	Retrospective registry cohort, 2000–2006	499 patients with blunt BSI
Post et al., 2013 [15]	Urban Level I trauma center, USA	Retrospective review, Jan 2008–Jun 2012	150 adults aged >18 years with AAST splenic injury grade ≤3 after exclusions
Yıldız et al., 2022 [12]	Ümraniye Training and Research Hospital, Türkiye	Retrospective analysis, Mar 2009–Jun 2021	158 stable or stabilized patients planned for NOM
Spoor et al., 2024 [8]	21 institutions, multicenter	Multicenter retrospective cohort, Jan 2014–Oct 2019	145 adults aged >18 years with grade I–II BSI plus CE; unstable and anticoagulated patients excluded

Table 2. outcome extraction table

Study	NOM	Main findings
Longo et al., 1989 [13]	Initial NOM cohort: 60/252 adults	NOM failed in 5 out of 60 patients. Failure reasons were blood loss >4 units, enlarging splenic defect, and increasing peritoneal signs. Predictors of success included hemodynamic stability, transfusion requirement <4 units, age <60 years, rapid GI recovery, and early imaging resolution.
Becker et al., 1994 [10]	Grade I–II subgroup: 25 patients	Of 25 patients with grade I–II injury, 20 were successfully treated with NOM and 5 required surgeries. In the full cohort, NOM was attempted in 36 and succeeded in 31. Delayed laparotomy occurred 1–8 days after CT.
Cocanour et al., 1998 [16]	NOM cohort: 87 adults	Six patients failed NOM within the first 48 hours, and 7/87 patients developed delayed complications after 48 hours. Delayed complication included bleeding at days 4, 6, and 8, plus splenic abscesses at 1 month.

Study	NOM	Main findings
Peitzman et al., 2000 [11]	Planned observation cohort within a 1,488-patient adult multicenter series	Failure of planned observation increased by AAST grade: grade I 4.8% and grade II 9.5%. Successful NOM was 75.0% for grade I and 70.0% for grade II. Overall planned observation failure was 10.8%. Most failures occurred early: 60.9% within 24 hours; 8% at 9 days or later.
Jeremitsky et al., 2011 [14]	Entire blunt BSI cohort: 499	Reported failed NOM / splenectomy events by grade: grade I 4 cases and grade II 9 cases. Nearly all grade I–II failures occurred within 24 hours. Splenic embolization was protective against splenectomy, HR 0.18.
Post et al., 2013 [15]	150 adults with AAST grade ≤3; 110 observed without blush, 18 observed with blush, 22 AE with blush	Patients with CT blush who were observed did not have significantly worse outcomes than those without blush. Among patients with blush, AE did not improve outcomes compared with observation.
Yıldız et al., 2022 [12]	Planned NOM cohort: 158 stable/stabilized patients	Success rates by grade were grade I 100% (20/20), grade II 96.3% (52/54), grade III 92.8% (52/56), grade IV 57.7%, and grade V 0%. Overall NOM success was 88.0%.
Spoor et al., 2024 [8]	145 adults with grade I–II injury and CE	Combined NOM failure for grade I–II with blush was 20.0%. Grade I failure was 18.2% and grade II failure was 21.1%. Failures had higher transfusion needs, more massive transfusion, and longer LOS.

Discussion

Our present study shows that non-operative management become the standard treatment for HDS adults with BSI and it preserves splenic function with avoidance of unnecessary laparotomy and postsplenectomy complications, and these findings agree with the general trauma literature [1,2,4,17]. This agreement is strongest in low-grade injury, and recent review papers report that failure rates are lowest in AAST grade I–II lesions and increase with higher grades, which is similar to the pattern seen in our findings [5,7]. One multicenter study reported failure rates of 4.8% for grade I and 9.5% for grade II, while a more recent retrospective study reported success rates of 100% for grade I and 96.3% for grade II injuries (Peitzman 2000; Yıldız 2022). These data make the present low-grade results clinically sensible, and support that most stable adults with grade I–II splenic trauma can be treated safely without immediate surgery when proper monitoring and hospital resources available [4,13,17].

Another important point in our findings is that NOM failure in low-grade injury was not common, and when it happened it appeared early after admission [7,14]. This timing is consistent with previous reports showing that most grade I–II failures occur within the first 24 hours, while broader reviews found that most failures of non-operative management are identified within the first 3 to 5 days of observation [7,14].

The predictors of NOM failure are lower systolic blood pressure, greater transfusion requirement, higher injury severity, and more extensive extra-abdominal injury [4,12]. Splenic grade alone is not enough to judge prognosis, and it explains why some minor splenic lesions still fail observation when the physiologic condition of the patient is worse [4,10,17]. The CE subgroup are the most difficult part to interpret, and this was also clear in our findings [8,15].

A single-center study found that low-grade patients with blush could be safely observed and that angioembolization did not improve outcomes [15]. The newer multicenter study restricted to grade I–II injuries with blush found a 20% failure rate with higher transfusion needs in those with failure [8]. This difference indicate that CE should not be treated as a simple decision point, and that the whole clinical picture is important, including hemodynamics, transfusion, associated injuries, and local access to angiography [4,7,8]. Embolization also had risk, because review articles describe infarction, abscess, and other procedure-related morbidity, so routine embolization for every low-grade lesion is not supported by the attached literature [7,18,19]. Delayed bleeding, pseudoaneurysm, and splenic abscess were reported after initial non-operative success, which supports careful short-term inpatient observation and appropriate follow-up even in patients with low-grade injuries who are stable at presentation [5,16].

Conclusion

NOM is effective approach for HDS adults with low-grade grade I–II BSI. We found high success rates and low failure in this patient group. Most failures occurred early after admission, which indicate the importance of close initial monitoring and repeated clinical assessment. Hemodynamic condition, transfusion need, and overall trauma burden seem to be more important predictors of failure than splenic grade alone. Patients with CE represent a higher-risk subgroup.

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List of abbreviations

AAST, American Association for the Surgery of Trauma
AE, Angioembolization
BSI, Blunt splenic injury
CE, Contrast extravasation
CT, Computed tomography
GI, Gastrointestinal
HDS, Hemodynamically stable
LOS, Length of hospital stay
NOM, Non-operative management
PICO, Population, Intervention, Comparator, Outcome
PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses

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