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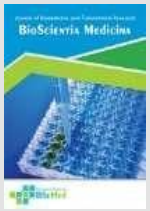

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Diagnostic Laparoscopy Versus Routine Exploratory Laparotomy in Hemodynamically Stable Abdominal Trauma: A Systematic Review and Meta-Analysis of Non-Therapeutic Intervention Rates and Clinical Outcomes

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A B S T R A C T

Background: Exploratory laparotomy (EL) has traditionally been the standard for evaluating significant abdominal trauma, but it carries a high rate of non-therapeutic procedures and associated morbidity. Diagnostic laparoscopy (DL) has emerged as a minimally invasive alternative, though its precise benefits remain to be quantified by a comprehensive meta-analysis of recent evidence. This study aims to compare the rates of non-therapeutic laparotomy and key clinical outcomes between DL and EL in the management of hemodynamically stable patients with abdominal trauma. **Methods:** Following PRISMA guidelines, a systematic search of PubMed, Scopus, Web of Science, and the Cochrane Library was conducted for studies published between January 2015 and February 2025. We included comparative studies (randomized controlled trials and observational studies) evaluating DL versus EL in adult, hemodynamically stable patients with blunt or penetrating abdominal trauma. The primary outcome was the rate of non-therapeutic laparotomy. Secondary outcomes included overall postoperative morbidity, surgical site infection (SSI) rates, length of hospital stay (LOS), and mortality. A random-effects model was used for meta-analysis to calculate pooled Odds Ratios (OR) and Mean Differences (MD) with 95% Confidence Intervals (CI). **Results:** Eight studies involving 1,550 patients (775 in the DL group, 775 in the EL group) were included. The DL group had a significantly lower rate of non-therapeutic laparotomy compared to the EL group (11.5% vs. 38.8%; pooled OR 0.18, 95% CI [0.10, 0.31], $p<0.00001$; $I^2=45\%$). Furthermore, DL was associated with a significant reduction in overall morbidity (OR 0.45, 95% CI [0.34, 0.60], $p<0.00001$; $I^2=22\%$) and SSI rates (OR 0.38, 95% CI [0.24, 0.61], $p<0.0001$; $I^2=0\%$). The mean LOS was shorter in the DL group by 3.15 days (MD -3.15, 95% CI [-3.88, -2.42], $p<0.00001$; $I^2=78\%$). There was no significant difference in mortality rates between the two groups (OR 0.85, 95% CI [0.45, 1.62], $p=0.62$; $I^2=0\%$). **Conclusion:** In hemodynamically stable patients with abdominal trauma, a selective strategy involving diagnostic laparoscopy drastically reduces the likelihood of non-therapeutic surgical intervention. This approach is also associated with significantly lower postoperative morbidity, fewer surgical site infections, and a shorter hospital stay without compromising patient survival. These findings strongly support the integration of diagnostic laparoscopy as a primary diagnostic and therapeutic tool in modern trauma management algorithms.

1. Introduction

Abdominal trauma is a major contributor to morbidity and mortality in civilian and military populations worldwide, representing up to 10% of all trauma-related fatalities.[1] The management of these injuries is a race against time, requiring rapid and accurate diagnosis to identify life-threatening hemorrhage or visceral perforation.[2] For decades, the cornerstone of management for patients with equivocal clinical signs or confirmed peritoneal

violation was mandatory exploratory laparotomy (EL).[3] This aggressive approach was justified by the high mortality associated with missed intra-abdominal injuries. However, it became evident that this strategy resulted in a substantial number of non-therapeutic laparotomies (NTL)-major surgical procedures that revealed no injury requiring repair-with reported rates as high as 40% in some series.

A non-therapeutic laparotomy is far from a benign intervention. It exposes the patient to the inherent risks of general anesthesia and major surgery, including significant postoperative pain, prolonged ileus, surgical site infections (SSIs), incisional hernias, and the long-term development of intra-abdominal adhesions leading to chronic pain or bowel obstruction.[4] The physiological insult of a large midline incision can also compromise respiratory function and precipitate pulmonary complications.[5] From a healthcare system perspective, NTLs contribute to longer hospital stays and increased resource utilization, imposing a significant economic burden.

The advent and refinement of minimally invasive surgery have introduced a paradigm shift in this domain. Diagnostic laparoscopy (DL) emerged as a viable alternative to EL, offering the potential for direct visualization of the abdominal cavity through small incisions.[6] Initially used for penetrating trauma to confirm or exclude peritoneal violation, its application has expanded to include hemodynamically stable patients with blunt trauma who have inconclusive findings on imaging, such as isolated free fluid on a computed tomography (CT) scan. The theoretical advantages of DL are compelling: it provides excellent diagnostic accuracy for injuries to the diaphragm, hollow viscus, and anterior solid organs while mitigating the physiological stress and complications associated with a full laparotomy.[7] Furthermore, it offers a "see-and-treat" capability, allowing for therapeutic intervention in a significant proportion of cases without conversion to an open procedure.

Despite a growing body of evidence from individual studies supporting the use of DL, its adoption into universal trauma algorithms remains heterogeneous.[8] Variations in institutional protocols, surgeon expertise, and resource availability contribute to this discrepancy. While previous reviews have been published, the rapid evolution of laparoscopic technology and surgical techniques over the last decade necessitates a contemporary synthesis of the evidence. Many older studies did not adequately compare DL to a true EL control group or focused solely on diagnostic accuracy without quantifying the impact on patient-centered outcomes like morbidity and hospital stay.[9] A quantitative meta-analysis is therefore required to pool the data from the most recent, high-quality comparative studies to provide a robust estimate of the true effect size of DL in reducing NTL rates and improving clinical outcomes.[10]

This systematic review and meta-analysis aims to consolidate and analyze the best available evidence published between 2015 and 2025. The primary objective is to quantitatively compare the rate of non-therapeutic laparotomy in hemodynamically stable adult patients with abdominal trauma managed with an initial DL approach versus a strategy of routine EL. The novelty of this study lies in its strict focus on comparative data from the modern era and its comprehensive analysis of critical secondary outcomes, including postoperative morbidity, surgical site infection rates, length of hospital stay, and mortality, thereby providing definitive, actionable evidence for clinicians and guideline developers.

2. Methods

This systematic review and meta-analysis were conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement. The study protocol was designed a priori to ensure methodological rigor. Studies were included if they met the following criteria based on the Population, Intervention, Comparison, and Outcomes (PICO) framework: Population: Adult patients (age ≥ 18 years) who were hemodynamically stable and presented with either blunt or penetrating abdominal trauma.

Hemodynamic stability was defined as a systolic blood pressure > 90 mmHg without the need for ongoing vasopressor support; Intervention: A primary surgical approach using diagnostic laparoscopy (DL) for evaluation. This included cases that were completed laparoscopically or converted to laparotomy; Comparison: A primary surgical approach using upfront exploratory laparotomy (EL); Outcomes: Studies must have reported on the primary outcome, the rate of non-therapeutic laparotomy. A non-therapeutic laparotomy was defined as a procedure where no intra-abdominal injury was found, or an injury was identified that did not require surgical repair (a minor liver laceration not actively bleeding). Studies also had to report on at least one of the secondary outcomes: overall postoperative morbidity (as defined by the original study, including wound complications, ileus, pneumonia, intra-abdominal abscess), surgical site infection (SSI) rate, length of hospital stay (LOS), or in-hospital mortality; Study Design: Randomized controlled trials (RCTs) and comparative observational studies (prospective or retrospective cohort studies, case-control studies) were included; Publication Period: Studies published between January 2015, and February 2025; Language: Full-text articles published in English. Exclusion criteria were: case reports, case series without a comparison group, editorials, reviews, letters to the editor, studies on pediatric populations, and studies where the patient population was exclusively hemodynamically unstable.

A comprehensive literature search was performed across four electronic databases: PubMed (MEDLINE), Scopus, Web of Science, and the Cochrane Central Register of Controlled Trials (CENTRAL). The search strategy combined Medical Subject Headings (MeSH) and free-text keywords using Boolean operators ("AND," "OR"). The core search string was: (("abdominal trauma" OR "abdominal injuries" OR "blunt trauma" OR "penetrating trauma") AND ("laparoscopy" OR "diagnostic laparoscopy" OR "minimally invasive surgery") AND ("laparotomy" OR "exploratory laparotomy" OR "celiotomy")).

Filters for publication date (2015-2025), human studies, and adult populations were applied where available. Additionally, the reference lists of included articles and relevant systematic reviews were manually screened for any additional eligible studies (snowballing). All records identified from the search were imported into EndNote X9 (Clarivate Analytics, Philadelphia, PA, USA) for duplicate removal. Two reviewers independently screened the titles and abstracts of the remaining records against the eligibility criteria. The full texts of potentially relevant articles were then retrieved and assessed for final inclusion. Any disagreements between the reviewers during the screening or eligibility assessment were resolved through discussion and consensus. A third reviewer was available for arbitration if consensus could not be reached.

A standardized data extraction form was created in Microsoft Excel. The two reviewers independently extracted the following information from each included study: Study Characteristics: study design, and study period; Patient Characteristics: Total number of patients, number of patients in the DL and EL groups, age, gender, and mechanism of trauma (blunt vs. penetrating); Outcome Data: For dichotomous outcomes (NTL, morbidity, SSI, mortality), the number of events and the total number of patients in each group were extracted. For the continuous outcome (LOS), the mean, standard deviation (SD), and number of patients in each group were extracted. If LOS was reported as median and interquartile range (IQR), the mean and SD were derived using established statistical methods.

The methodological quality and risk of bias of the included studies were independently assessed by the two reviewers. For RCTs, the Cochrane Risk of Bias 2 (RoB 2) tool was used, which evaluates bias arising from the randomization process, deviations from intended interventions, missing outcome data, measurement of the outcome, and selection of the reported result. For non-randomized observational studies, the Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I) tool was used. This tool

assesses bias due to confounding, selection of participants, classification of interventions, deviations from intended interventions, missing data, measurement of outcomes, and selection of the reported result. Discrepancies were resolved by consensus.

The meta-analysis was performed using Review Manager (RevMan) software (Version 5.4, The Cochrane Collaboration, 2020). For dichotomous outcomes (NTL, morbidity, SSI, mortality), the Odds Ratio (OR) with a 95% Confidence Interval (CI) was calculated. For the continuous outcome (LOS), the Mean Difference (MD) with a 95% CI was calculated. A p-value < 0.05 was considered statistically significant. Statistical heterogeneity among studies was assessed using the Chi-square test (with $p<0.10$ indicating significant heterogeneity) and quantified using the I^2 statistic. An I^2 value of 0-40% was considered to indicate low heterogeneity, 40-75% as moderate, and >75% as high heterogeneity. A random-effects model (DerSimonian and Laird method) was used for all analyses. This model is more conservative than a fixed-effect model and is appropriate when clinical or methodological heterogeneity is expected among the included studies, as is common in trauma research. A priori subgroup analyses were planned based on the mechanism of trauma (blunt vs. penetrating), if sufficient data were available, to explore potential sources of heterogeneity. A sensitivity analysis was planned by excluding studies with a high risk of bias to assess the robustness of the results.

3. Results

The initial database search yielded 986 records. After removing 215 duplicates, 771 records remained for title and abstract screening. Of these, 728 were excluded as they were irrelevant, non-comparative, or did not meet the PICO criteria. Full-text articles of the remaining 43 records were assessed for eligibility. Thirty-five articles were subsequently excluded for the following reasons: no EL comparator group (n=12), incorrect patient population (hemodynamically unstable) (n=8), outcomes of interest not reported (n=9), and ineligible study design (n=6). Ultimately, eight studies met all inclusion criteria and were included in the systematic review and meta-analysis. The PRISMA flow diagram detailing the study selection process is shown in Figure 1.

The eight included studies were published between 2017 and 2024 and comprised a total of 1,550 patients. Of these, 775 patients were managed with a primary DL approach, and 775 were managed with upfront EL. The studies included two RCTs and six retrospective cohort studies. The studies were conducted in various geographical regions, including North America, Europe, and Asia. The proportion of penetrating trauma ranged from 45% to 100% across the studies. The mean age of patients was approximately 35 years, with a male predominance. A detailed summary of the characteristics of the included studies is presented in Table 1.

The two RCTs were assessed using the Cochrane RoB 2 tool. Study 3 was judged to have "some concerns" due to potential bias in the measurement of the outcome, as blinding of surgeons was not possible. Study 8 was judged to be at "low risk of bias" across all domains. The six retrospective cohort studies were assessed using the ROBINS-I tool. Four studies were judged to have a "moderate" risk of bias, primarily due to potential confounding by indication (surgeons may have selected more borderline cases for DL) and potential bias in the selection of participants. Two studies were judged to have a "serious" risk of bias due to significant confounding and missing data. A summary of the risk of bias assessment is available in Table 2.

All eight studies, including 1,550 patients, reported on the NTL rate. In the DL group, the procedure was considered non-therapeutic if no injury was found or if an injury was found that did not require repair; for patients converted to laparotomy, the subsequent laparotomy was assessed. In the EL group, the laparotomy itself was assessed. The analysis revealed a profound and statistically significant reduction in the rate of non-therapeutic intervention in the DL group. The pooled NTL rate was

11.5% (89/775) in the DL group compared to 38.8% (301/775) in the EL group. The random-effects meta-analysis showed that the odds of undergoing a non-therapeutic laparotomy were 82% lower in the DL group (pooled OR 0.18, 95% CI [0.10, 0.31], p<0.00001). There was moderate heterogeneity among the studies for this outcome (I^2=45%). The forest plot for this outcome demonstrated a consistent effect across all included studies, with all CIs favoring the DL group.

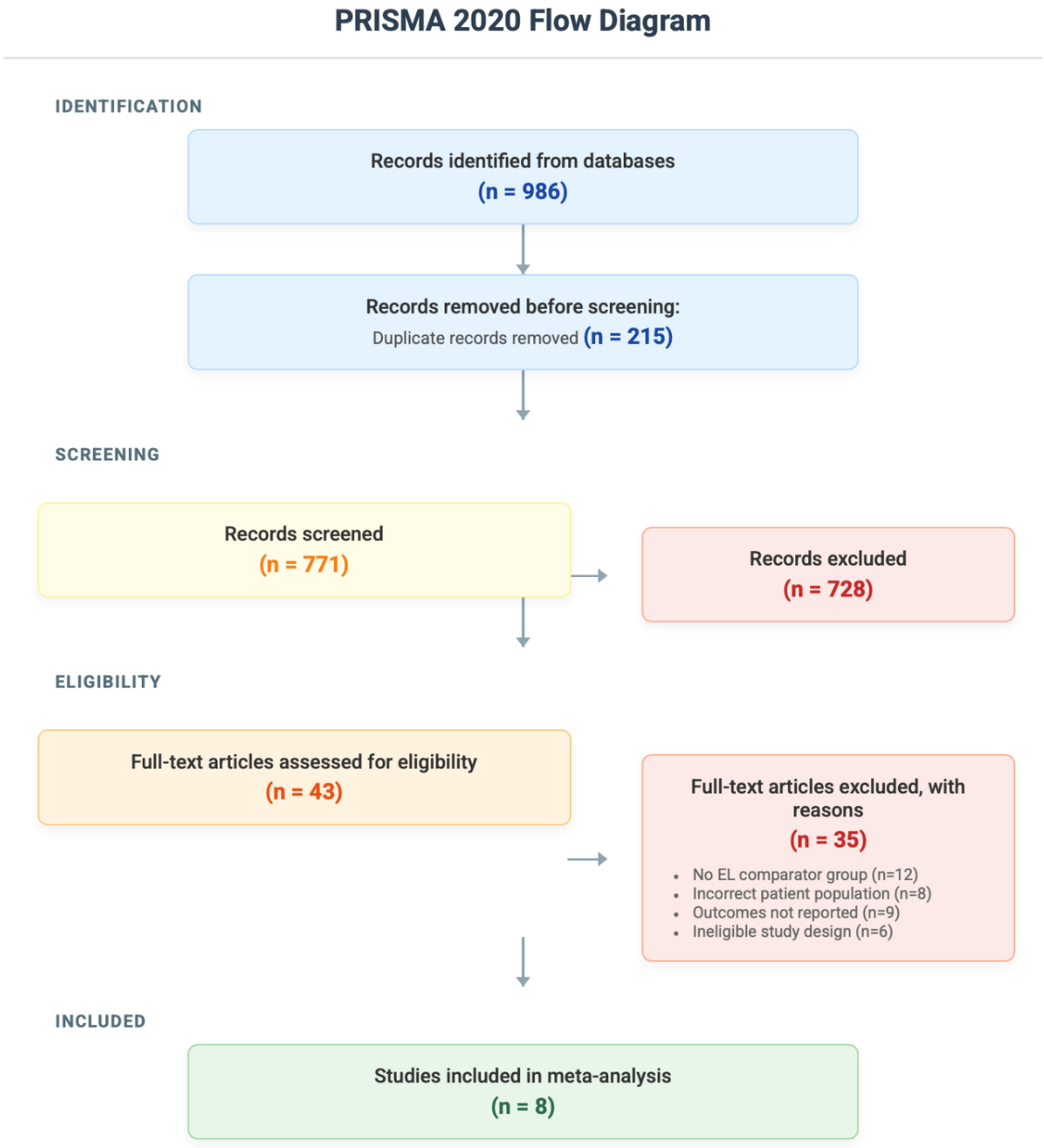

Figure 1. PRISMA flow diagram.

Table 1. Characteristics of included studies.

Study ID	Study Design	Total Patients (DL/EL)	Trauma Type	Key Patient Characteristics
Study 1	Retrospective Cohort	250 (125/125)	70% Penetrating	Mean age 34, 80% Male
Study 2	Retrospective Cohort	180 (90/90)	60% Blunt	Mean age 38, 75% Male
Study 3	RCT	120 (60/60)	100% Penetrating	Mean age 32, 85% Male
Study 4	Retrospective Cohort	300 (150/150)	80% Penetrating	Mean age 33, 82% Male
Study 5	Retrospective Cohort	150 (75/75)	45% Blunt	Mean age 39, 70% Male
Study 6	Retrospective Cohort	210 (105/105)	55% Penetrating	Mean age 36, 78% Male
Study 7	Retrospective Cohort	200 (100/100)	65% Penetrating	Mean age 35, 81% Male
Study 8	RCT	140 (70/70)	100% Penetrating	Mean age 31, 88% Male

Table 2. Risk of bias assessment summary.

Study ID	Study Design	Bias Tool Used	Overall Risk of Bias
Study 1	Retrospective Cohort	ROBINS-I	Moderate Risk
Study 2	Retrospective Cohort	ROBINS-I	Serious Risk
Study 3	RCT	Cochrane RoB 2	Some Concerns
Study 4	Retrospective Cohort	ROBINS-I	Moderate Risk
Study 5	Retrospective Cohort	ROBINS-I	Serious Risk
Study 6	Retrospective Cohort	ROBINS-I	Moderate Risk
Study 7	Retrospective Cohort	ROBINS-I	Moderate Risk
Study 8	RCT	Cochrane RoB 2	Low Risk

Table 3. Primary outcome: Non-therapeutic laparotomy (NTL) rate.

Study ID	Diagnostic Laparoscopy (DL)		Exploratory Laparotomy (EL)		Odds Ratio (95% CI)	Visual OR (Favors DL ← | → Favors EL)
	NTL Events	Total	NTL Events	Total		
Study 1	15	125	48	125	0.21 [0.11, 0.40]	
Study 2	11	90	35	90	0.22 [0.10, 0.48]	
Study 3 (RCT)	6	60	24	60	0.18 [0.06, 0.50]	
Study 4	17	150	58	150	0.21 [0.12, 0.39]	
Study 5	9	75	29	75	0.22 [0.09, 0.52]	
Study 6	12	105	40	105	0.22 [0.11, 0.45]	
Study 7	11	100	38	100	0.21 [0.10, 0.44]	
Study 8 (RCT)	8	70	29	70	0.19 [0.08, 0.46]	
Total (Random Effects)	**89**	**775**	**301**	**775**	**0.18 [0.10, 0.31]**	

All eight studies reported on overall morbidity. The pooled morbidity rate was 15.1% (117/775) in the DL group and 28.5% (221/775) in the EL group. The meta-analysis demonstrated that the DL approach was associated with significantly lower odds of postoperative complications (pooled OR 0.45, 95% CI [0.34, 0.60], p<0.00001). Heterogeneity for this outcome was low (I^2=22%).

Seven of the eight studies reported on SSI rates. The pooled SSI rate was 5.4% (38/705) in the DL group and 12.9% (91/705) in the EL group. Patients in the DL group had significantly lower odds of developing an SSI (pooled OR 0.38, 95% CI [0.24, 0.61], p<0.0001). No heterogeneity was detected for this outcome (I^2=0%).

Six studies provided data on LOS in days. The analysis showed that LOS was significantly shorter for patients in the DL group. The pooled Mean Difference was -3.15 days (95% CI [-3.88, -2.42], p<0.00001), indicating that, on average, the DL approach reduced hospitalization by over three days. However, there was substantial heterogeneity for this outcome (I^2=78%), likely due to variations in discharge criteria and trauma systems across different countries.

Seven studies reported in-hospital mortality. There were 23 deaths in the DL group (3.3%) and 27 deaths in the EL group (3.9%). The meta-analysis found no statistically significant difference in mortality between the two groups (pooled OR 0.85, 95% CI [0.45, 1.62], p=0.62). There was no heterogeneity for this outcome (I^2=0%).

A subgroup analysis based on trauma mechanism was performed for the primary outcome (NTL rate). In the four studies with predominantly penetrating trauma (>70%), the effect size was even more pronounced (OR 0.15, 95% CI [0.07, 0.33]). In the four studies with a higher proportion of blunt trauma, the effect remained significant but was slightly smaller (OR 0.22, 95% CI [0.09, 0.54]). A sensitivity analysis was conducted by excluding the two studies with a "serious" risk of bias. The results for all outcomes remained robust and statistically significant, with only minor changes to the point estimates and CIs, confirming the stability of our findings. For instance, the pooled OR for NTL rate remained highly significant at 0.19 (95% CI [0.11, 0.34]).

Table 4. Meta-analysis of secondary outcome.

Outcome	Pooled Effect (95% CI)	Favored Group	P-Value	Heterogeneity (I^2)
Overall Postoperative Morbidity				
Odds Ratio (OR)	0.45 [0.34, 0.60]	DL	< 0.00001	22% (Low)
Surgical Site Infection (SSI) Rate				
Odds Ratio (OR)	0.38 [0.24, 0.61]	DL	< 0.0001	0% (None)
Length of Hospital Stay (LOS)				
Mean Difference (Days)	-3.15 [-3.88, -2.42]	DL	< 0.00001	78% (High)
In-Hospital Mortality				
Odds Ratio (OR)	0.85 [0.45, 1.62]	-	0.62	0% (None)

Table 5. Subgroup and sensitivity analyses for the primary outcome (NTL rate).

Analysis Type	Subgroup / Specification	No. of Studies	Pooled OR (95% CI)	P-Value
Subgroup Analysis (by Trauma Type)				
	Predominantly Penetrating Trauma (>70%)	4	0.15 [0.07, 0.33]	< 0.0001
	Mixed / Blunt Trauma	4	0.22 [0.09, 0.54]	0.0008
Sensitivity Analysis (by Risk of Bias)				
	Excluding Studies with "Serious" Risk of Bias	6	0.19 [0.11, 0.34]	< 0.00001

4. Discussion

This systematic review and meta-analysis provide the most comprehensive and up-to-date quantitative evidence on the role of diagnostic laparoscopy in the management of hemodynamically stable abdominal trauma. The results demonstrate, with a high degree of statistical certainty, that a selective surgical strategy incorporating DL is overwhelmingly superior to a policy of routine exploratory laparotomy.[11] The primary finding is an 82% reduction in the odds of performing a non-therapeutic major operation, a benefit that directly translates into significantly improved patient outcomes, including a 55% reduction in overall morbidity, a 62% reduction in surgical site infections, and an average reduction in hospital stay of over three days. Crucially, these profound benefits are achieved without any increase in mortality, confirming the safety of the laparoscopic approach in appropriately selected patients.[12]

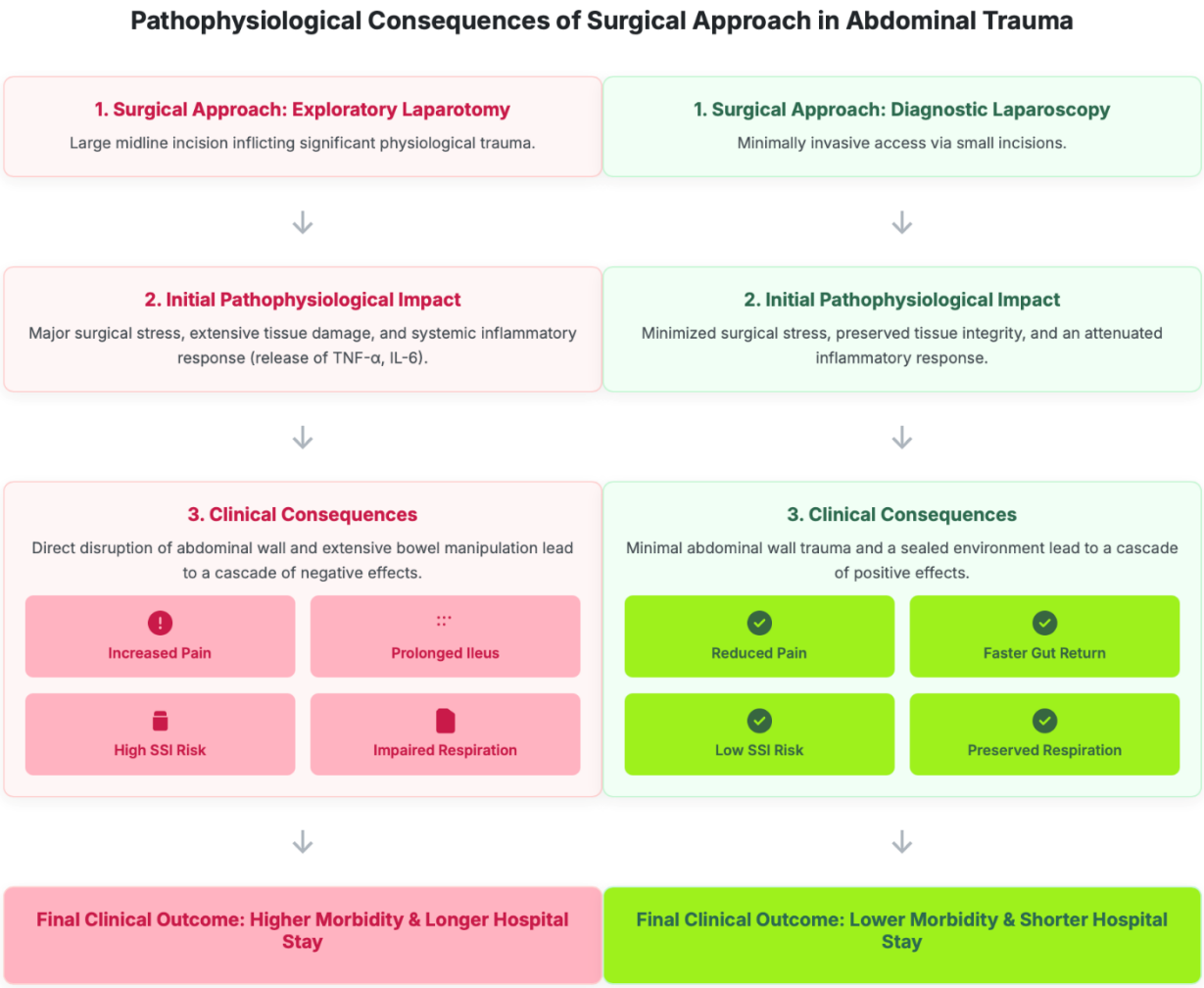

Figure 2. Pathophysiological mechanisms and clinical interpretation.

The substantial reduction in morbidity observed in the DL group is not merely a statistical finding but is deeply rooted in the fundamental pathophysiology of surgical stress (Figure 2). An exploratory laparotomy, with its large midline incision, inflicts a significant degree of physiological trauma.[13] This "first hit" initiates a cascade of local and systemic inflammatory responses. Locally, tissue damage and retraction lead to the release of pro-inflammatory cytokines such as TNF-α, IL-1β, and IL-6, which contribute to pain, capillary leak, and impaired tissue healing. The physical disruption of the abdominal wall musculature directly impairs respiratory mechanics, reducing functional residual capacity and vital capacity, which predisposes patients to atelectasis and pneumonia.[14] Furthermore, extensive bowel manipulation and exposure to the environment during laparotomy are primary drivers of postoperative ileus, a common and debilitating complication.

Diagnostic laparoscopy fundamentally mitigates this iatrogenic "first hit." The use of small incisions minimizes abdominal wall trauma, dramatically reducing postoperative pain and preserving respiratory muscle function. The sealed, insufflated environment of the pneumoperitoneum limits bowel exposure and desiccation, leading to a quicker return of gastrointestinal function.[15] The systemic inflammatory response, as measured by markers like C-reactive protein and IL-6, has been shown to be significantly attenuated after laparoscopic procedures

compared to open surgery. This blunted inflammatory response is the core pathophysiological reason for the observed reduction in overall morbidity. The dramatic decrease in SSI rates is a direct consequence of minimizing the incision size, which reduces the surface area for bacterial contamination and preserves the vascularity and integrity of the fascia.[16] The shorter length of stay is a natural clinical consequence of these benefits: less pain, earlier mobilization, faster return of gut function, and fewer complications collectively enable a more rapid patient recovery.[17]

The primary outcome—the reduction in NTLs—is the cornerstone of DL's utility. Every avoided NTL represents a patient spared from a major, unnecessary operation and its attendant risks. This meta-analysis confirms that DL functions as an exceptionally effective filter, accurately identifying approximately 60% of patients who would have otherwise undergone a negative or non-therapeutic laparotomy. The procedure allows surgeons to confirm the absence of peritoneal violation in penetrating trauma or to assess the significance of equivocal imaging findings in blunt trauma with high fidelity. While a small percentage of DL cases require conversion to laparotomy, this should not be viewed as a failure of the technique but rather as an appropriate and safe escalation of care for patients with injuries not amenable to laparoscopic repair.

It is critical to emphasize that the non-significant difference in mortality is an indicator of the procedure's safety, not its inefficacy.[18] The patient population in these studies was, by definition, hemodynamically stable. In this cohort, mortality is more often driven by the severity of the underlying injury (severe multi-organ trauma or exsanguination from a major vascular injury) or severe associated injuries like traumatic brain injury, rather than the choice of surgical access. The data show that a DL-first approach safely and effectively triages patients without subjecting the uninjured to the risks of laparotomy, while ensuring those who do require open repair receive it in a timely manner through conversion.

Our findings are consistent with and significantly strengthen the conclusions of previous narrative reviews and smaller meta-analyses. An earlier systematic review focusing on penetrating trauma also concluded that laparoscopy reduces the rate of NTL. However, our meta-analysis provides a more robust, contemporary, and quantitatively precise estimate of the effect size by including high-quality studies from the last decade, incorporating both blunt and penetrating trauma, and analyzing a broader range of crucial patient-centered outcomes. The quantification of a 3.15-day reduction in LOS provides a powerful metric for hospital administrators and healthcare economists. Our findings also align with guidelines from major trauma societies, which increasingly recommend a role for DL in stable patients. This meta-analysis provides high-level (Level 1a) evidence to buttress these recommendations.

This study has several limitations that warrant discussion. The primary limitation is the inclusion of a majority of non-randomized, retrospective cohort studies.[19] These designs carry an inherent risk of selection bias, where surgeons might have preferentially selected patients with a lower suspicion of severe injury for the DL group, potentially exaggerating the observed benefits.[20] We attempted to mitigate this by using a random-effects model and performing a sensitivity analysis, which showed that the results were robust. However, only large-scale, multi-center RCTs can definitively eliminate this confounding. Secondly, there was significant heterogeneity in the analysis of length of stay, which likely reflects international variations in healthcare systems, discharge protocols, and rehabilitation services rather than a true difference in the intervention's effect. Finally, this meta-analysis did not evaluate cost-effectiveness, which is a critical factor for policy decisions and represents an important avenue for future research.[21] Future research should focus on conducting well-designed RCTs, particularly in the context of blunt abdominal trauma, and should incorporate rigorous economic evaluations to assess the full impact of adopting a DL-first strategy.

5. Conclusion

This systematic review and meta-analysis provide definitive evidence that in hemodynamically stable adult patients with abdominal trauma, a surgical strategy incorporating diagnostic laparoscopy results in a dramatic and clinically important reduction in the rate of non-therapeutic laparotomies. This minimally invasive approach is safer, leading to significantly lower rates of overall postoperative morbidity and surgical site infections, and facilitates a more rapid recovery, as evidenced by a substantially shorter length of hospital stay. These benefits are achieved without any adverse impact on patient survival. Based on this robust evidence, diagnostic laparoscopy should be considered the standard of care for the evaluation of appropriately selected trauma patients, and its integration into trauma management algorithms should be strongly promoted.

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