



Surgical Strategies and Prognostic Factors in Invasive Bladder Cancer: A Systematic Review

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Article History :

Received date : 2024/08/25

Revised date : 2024/09/12

Accepted date : 2024/10/24

Published date : 2024/11/15



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E-ISSN :

ISSN 3048-1368



P-ISSN :

ISSN 3048-1376



ABSTRACT

Background: Invasive bladder cancer presents a substantial health challenge due to its aggressive nature and high incidence. Surgical management, primarily through open radical cystectomy (ORC), laparoscopic radical cystectomy (LRC), and robotic-assisted radical cystectomy (RARC), is essential in treating this malignancy. Understanding the comparative outcomes of these surgical approaches and identifying prognostic factors is crucial to optimize patient care. **Methods:** This systematic review synthesized data from studies meeting specific inclusion criteria focused on the outcomes of ORC, LRC, and RARC for invasive bladder cancer. Major databases, including Emerald, Science Direct, and Sagepub, were searched to collate relevant studies. Key aspects analyzed included perioperative outcomes, oncological results, and the influence of prognostic factors such as lymph node dissection and surgical margin status. **Results:** The review revealed that minimally invasive techniques, namely LRC and RARC, demonstrate comparable oncologic outcomes to ORC, with distinct advantages in perioperative recovery, including reduced blood loss and shorter hospital stays. Prognostic factors like extensive lymph node dissection and achieving negative surgical margins were associated with improved survival and recurrence rates. **Conclusion:** The findings support that the choice of surgical approach should be tailored based on patient-specific factors and institutional expertise to enhance outcomes. High-quality, individualized surgical care is paramount, emphasizing the role of centralizing bladder cancer surgeries to high-volume centers and establishing referral networks for optimal patient management.

Keywords: Surgical Strategies, Prognostic Factors, Invasive Bladder Cancer

INTRODUCTION

Muscle-invasive bladder cancer (MIBC) is a significant health concern due to its aggressive nature and high prevalence. It accounts for a substantial portion of bladder cancer cases and often requires intensive treatment strategies to manage effectively. MIBC is characterized by the invasion of cancer cells into the muscle layer of the bladder, leading to a higher risk of metastasis and poorer prognosis if not treated promptly and effectively. The aggressive progression of MIBC necessitates robust surgical interventions to improve survival rates and quality of life for patients [1].

The standard treatment for MIBC includes radical cystectomy (RC), which involves the removal of the bladder along with surrounding tissues. This approach is considered the gold standard due to its effectiveness in controlling localized disease [2]. However, it is associated with significant morbidity and potential complications. In recent

years, bladder-preserving strategies, such as chemoradiation, have emerged as viable alternatives for selected patients. These strategies aim to maintain bladder function while providing oncologic control comparable to RC. Minimally invasive techniques, including laparoscopic radical cystectomy (LRC) and robotic-assisted radical cystectomy (RARC), have gained popularity due to their potential benefits in reducing perioperative complications and improving recovery times [3].

This study aims to evaluate and compare the outcomes of various surgical approaches in managing invasive bladder cancer, particularly focusing on open radical cystectomy (ORC), laparoscopic radical cystectomy (LRC), and robotic-assisted radical cystectomy (RARC). Additionally, this review seeks to identify prognostic factors that influence surgical outcomes, with the goal of providing guidance in optimizing treatment strategies for patients with MIBC.

Different views exist regarding the management of invasive bladder cancer, especially concerning the effectiveness of radical cystectomy (RC) versus bladder-preserving strategies such as chemoradiation. Some studies suggest that bladder-preserving strategies can offer comparable oncologic outcomes for selected patients. However, debates remain on the long-term efficacy and associated complications of these approaches compared to RC, which is widely regarded as the gold standard for MIBC management [4].

Bladder cancer poses a significant global health burden, particularly in cases of MIBC with its high risk of metastasis and poor prognosis if untreated. It represents a considerable cause of morbidity and mortality among urologic cancers, with treatment methods profoundly impacting patient quality of life. Consequently, studying optimal surgical approaches for MIBC is increasingly important to improve standards of care and long-term health outcomes for patients worldwide [5].

By comparing the surgical outcomes of various approaches, this systematic review is expected to highlight the advantages and limitations of each method and provide practical recommendations for selecting the most suitable treatment strategy for MIBC patients. The insights gained from this literature review aim to contribute to clinical practice improvements and guide future research directions in the surgical management of bladder cancer.

METHODS

Literature Search Strategy

In developing a literature search strategy for the journal article titled “Surgical Strategies and Prognostic Factors in Invasive Bladder Cancer: A Systematic Review,” several approaches helped to comprehensively expand the scope of the study. Following PRISMA 2020 guidelines to ensure transparent and thorough reporting, a literature search was conducted in major databases such as Emerald, Science Direct and Sagepub to identify relevant studies related to the role of

“radical cystectomy” in the management of “muscle-invasive bladder cancer” (MIBC). In addition to these major databases, considering adding other relevant databases such as the Cochrane Library which focuses on systematic reviews and clinical trials, Scopus for a wider coverage of international journals, and Google Scholar for articles that may not be indexed in the major databases, will enrich the selection of available literature and improve the quality of the search.

To broaden the scope of the search, a wide variety of keywords can be used to capture the variety of terminology used in the medical literature. Additional relevant keywords include “Invasive Bladder Cancer,” “Muscle-invasive Urothelial Carcinoma,” “Robotic Cystectomy,” “Laparoscopic Cystectomy,” “Lymph Node Dissection,” “Oncological Outcomes,” “Perioperative Morbidity,” and “Patient Survival in Bladder Cancer.” These keyword combinations allow focusing on the main aspects to be studied, such as different surgical approaches, oncological outcomes, and

perioperative complications in patients with MIBC.

The use of time search filters, for example limiting the search to the last 12 years, and the application of Boolean logic will further help narrow down the search results to make them more relevant. For example, the application of Boolean logic such as (“muscle-invasive bladder cancer” OR “invasive urothelial carcinoma”) AND (“radical cystectomy” OR “bladder preservation”) AND (“oncological outcomes” OR “survival rate”) will help identify studies that specifically match the search criteria.

In addition, expanding the keywords to prognostic factors associated with surgical outcomes may add a deeper understanding of the variables that influence the success of surgical procedures. Keywords related to these prognostic factors include “Lymphovascular Invasion,” “Surgical Margin Status,” “Extent of Lymph Node Dissection,” “Surgeon Volume” and “Hospital Volume,” as well as “Comorbidities” and “Charlson Comorbidity Index.” With this designed strategy, the study

was able to utilize high-quality, relevant literature focused on critical aspects of invasive bladder cancer treatment through cystectomy procedures. This comprehensive approach is expected to yield in-depth analysis and support stronger conclusion regarding surgical strategies and prognostic factors in patients with invasive bladder cancer.

Criteria for Eligibility

The eligibility criteria for this systematic review were carefully defined to ensure the inclusion of relevant and high-quality studies focused on the surgical outcomes of various approaches in managing muscle-invasive bladder cancer (MIBC). Eligible studies were peer-reviewed research articles, including Randomized Controlled Trials (RCTs) and prospective or retrospective cohort studies that evaluated open radical cystectomy (ORC), laparoscopic radical cystectomy (LRC), and robotic-assisted radical cystectomy (RARC) in patients with MIBC. The studies needed to provide comprehensive data on perioperative outcomes,

survival rates, and relevant prognostic factors.

Data Retrieval

The data retrieval process involved a systematic extraction of critical information from studies that met the inclusion criteria. Specifically, studies included were those focused on patients with muscle-invasive bladder cancer (MIBC) undergoing open radical cystectomy (ORC), laparoscopic radical cystectomy (LRC), or robot-assisted radical cystectomy (RARC), and were published within the last 12 years. Data collected encompassed study design, patient demographics, details of surgical techniques employed, perioperative outcomes, and long-term survival rates. Additionally, key prognostic factors influencing surgical outcomes, such as the extent of lymph node dissection and surgical margins, were identified and documented. To ensure high-quality evidence, only peer-reviewed randomized controlled trials (RCTs) and cohort studies (both prospective and retrospective) were included, with case reports, case series, and review articles excluded. Studies

focusing on non-invasive bladder cancers or cancers unrelated to the bladder were also excluded, as were those with inadequate sample sizes or that were published in languages other than English.

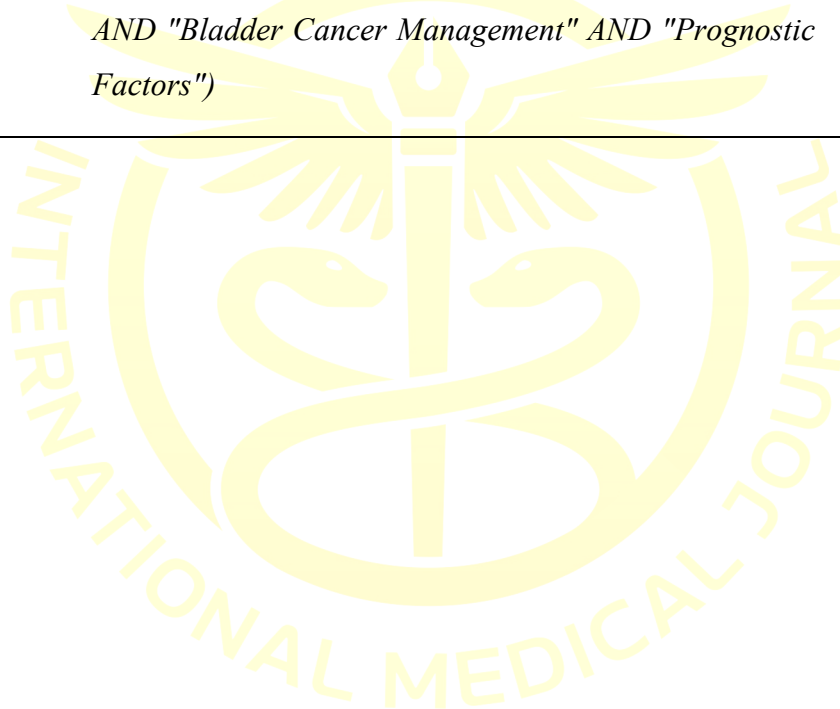
Data extraction was performed independently by multiple reviewers to minimize bias and maintain accuracy. Any discrepancies in data interpretation or extraction were resolved through discussion or consultation with a third reviewer when necessary. This meticulous approach ensured a thorough and robust analysis of the current literature on surgical management strategies for MIBC. The inclusion of only relevant, high-quality studies strengthened the validity of our findings and helped ensure that the conclusions drawn reflect the most current and reliable evidence in the field of bladder cancer surgery.

Quality Assessment

The quality of the included studies was assessed using tools appropriate to their study design, such as the Cochrane Risk of Bias tool for randomized controlled trials and the Newcastle-Ottawa Scale for cohort studies. Each study was evaluated based on criteria including selection bias, performance bias, detection bias, and reporting bias. Emphasis was placed on methodological rigor, including clear randomization processes, adequate follow-up durations, and comprehensive outcome reporting. High-quality studies demonstrating robust methodologies were prioritized to ensure that the data contributed are reliable and significantly enhance our understanding of surgical outcomes in the management of invasive bladder cancer. This rigorous assessment strengthens the validity of the review's findings and supports its clinical relevance for future urological surgical practices.

Tabel 1 Search Strategy

Database	Search Strategy	Hits
Emerald	<i>("Invasive Bladder Cancer" AND "Surgical Outcomes" AND "Bladder Cancer Management" AND "Prognostic Factors")</i>	5
Science Direct	<i>("Invasive Bladder Cancer" AND "Surgical Outcomes" AND "Bladder Cancer Management" AND "Prognostic Factors")</i>	343
Sagepub	<i>("Invasive Bladder Cancer" AND "Surgical Outcomes" AND "Bladder Cancer Management" AND "Prognostic Factors")</i>	22



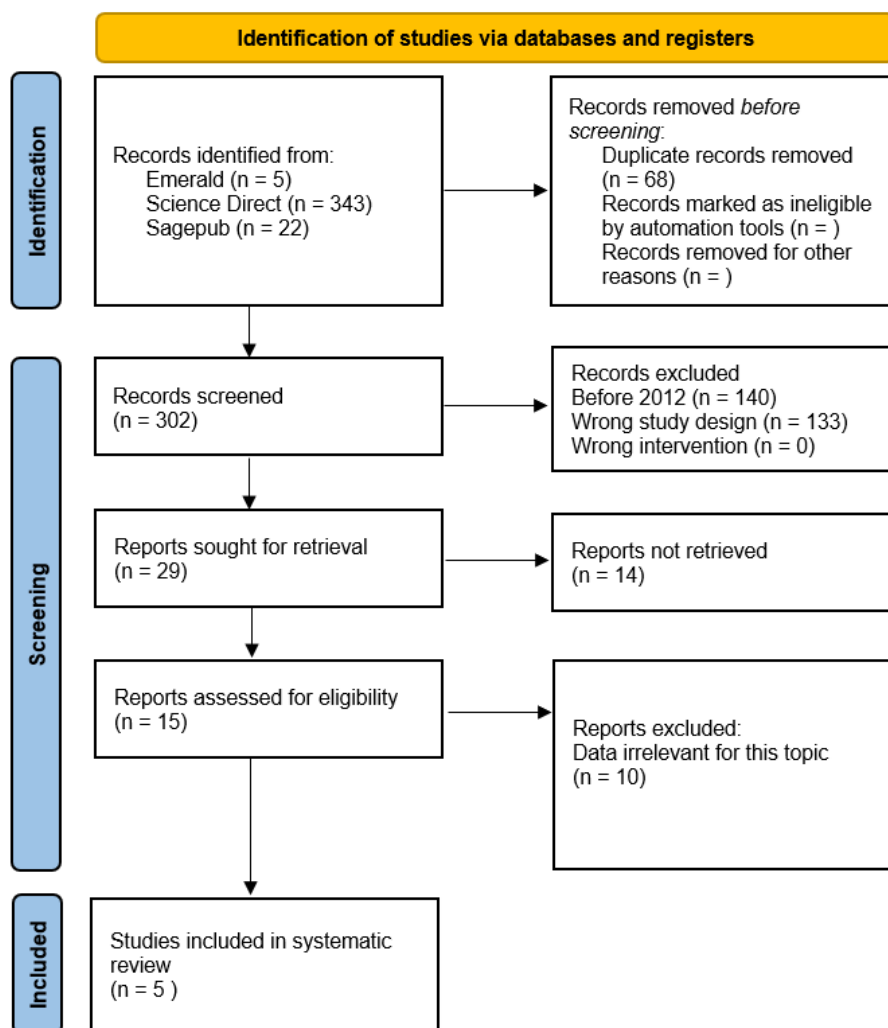


Figure 1 Article search flow chart

RESULT

Our research began with a methodical collection of numerous papers from credible databases including Science Direct, Sagepub, and Emerald. Following a comprehensive three-phase screening process, we identified fifth papers deemed highly relevant to our ongoing systematic review. We then selected specific topics for further analysis and carefully assessed each report. To streamline our study, we have included a brief overview of the evaluated information in Table 2.

Tabel 2 Summary of Studies

Article	Method	Sample	Focus	Prognostic Factors	Result
Robotic and Laparoscopic Radical Cystectomy for Bladder Cancer: Long-term Oncologic Outcomes [6]	Retrospective, longitudinal study	121 patients treated with RARC or LRC for bladder cancer	Assessing the long-term outcomes of RARC and LRC in bladder cancer patients	Tumor invasiveness grade, number of lymphatic nodes retrieved, surgical margin status	The study showed that at a follow-up of up to 10 years, the Overall Survival (OS) rate was 35%, Cancer-Specific Survival (CSS) 63%, and Recurrence-Free Survival (RFS) 54%. These results are close to those achieved with the open surgery method. Most patients (48%) showed no signs of disease at the end of follow-up, although 23% died from cancer-related causes. Analysis also revealed that the number of lymphatic nodes retrieved had an effect on long-term outcomes, with

patients who had more than 14 nodes retrieved showing a better OS. However, complications, such as positive soft tissue margins (6.6%) and postoperative complication-related mortality (Clavien grade 3-5 in 19%), were more common in patients with extravesical and highly invasive disease. This analysis highlights the importance of more extensive lymphatic node dissection and meticulous surgery to achieve consistent negative margins in RARC and LRC procedures.

Oncological outcomes in patients treated with radical cystectomy for bladder cancer: Comparison between open, laparoscopic, and robot-	Retrospective analysis of oncological outcomes and perioperative variables for	230 patients underwent open radical cystectomy (ORC), laparoscopic radical cystectomy (LRC), or robotic-assisted radical cystectomy	Comparison of oncological outcomes in muscle-invasive bladder cancer patients treated with different surgical approaches (ORC, LRC, RARC)	Pathologic tumor stage, lymphovascular invasion (LVI), positive surgical margin (PSM), BMI, ASA score, intraoperative blood transfusion, age.	The results showed that the type of surgical approach (open radical cystectomy (ORC), laparoscopic radical cystectomy (LRC), and robotic-assisted radical cystectomy (RARC)) had no significant effect on recurrence-free survival (RFS),
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assisted
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[7]

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cancer-specific survival (CSS), or overall survival (OS) in patients with invasive bladder cancer. Further analysis showed that the main prognostic factors associated with worse clinical outcomes were the tumor stage of pathology, presence of lymphovascular invasion (LVI), and positive surgical margins (PSM). Patients with higher tumor stage ($\geq pT3$) as well as those with LVI and PSM tended to have a higher risk of recurrence and mortality. In addition, body mass index (BMI), ASA score (surgical risk assessment related to general health condition), and intraoperative blood transfusion were found to be correlated with increased mortality risk. Age was also identified as an independent predictor of overall mortality. This study suggests that



although minimally invasive approaches (LRC and RARC) offer advantages in terms of perioperative complications, they do not affect long-term oncologic outcomes.

Optimizing surgical outcomes in bladder cancer patients undergoing radical cystectomy [8]	Systematic review on predictors of high-quality surgery in radical cystectomy for bladder cancer	Literature-based review; references from multiple studies	Evaluation of surgical strategies in bladder cancer patients undergoing radical cystectomy	- Negative surgical margins - Number of lymph nodes (LNs) resected - Lymph node dissection (LND) template - Surgical volume	Surgical Techniques and Oncology: Optimal radical cystectomy technique has a significant impact on oncologic outcomes in invasive bladder cancer. Studies have shown that the presence of negative surgical margins and adequate number of LNs removed (>10 LNs) are highly influential in reducing the risk of local recurrence and improving patient survival. Comparison of Robotic and Open Techniques: Robotic approaches show comparable oncologic outcomes to open techniques in terms of safety and effectiveness, although robotics
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has advantages such as reduced blood loss and postoperative complications. Volume of Surgery: High surgical volumes at specialized centers result in better outcomes in terms of low complications, faster recovery, and lower mortality, suggesting that centers with more cancer cases have an advantage in more effective care.

The Importance of Hospital and Surgeon Volume as Major Determinants of Morbidity and Mortality After Radical Cystectomy for Bladder Cancer: A Systematic Review and Recommendations by the European Association of Urology Muscle-invasive and	Systematic Review	39 studies, 549,542 patients	Impact of HV and SV on outcomes in bladder cancer surgery	Hospital volume (HV) and surgeon volume (SV).	This study found that hospital volume (HV) has a significant association with clinical outcomes in bladder cancer patients undergoing radical cystectomy (RC) procedures. Hospitals with high HV (>10 RCs per year) showed reduced in-hospital mortality rates, as well as within 30 and 90 days postoperatively, compared to hospitals with low HV. The study also showed that higher
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Metastatic
Bladder
Cancer
Guideline
Panel [9]

HV can positively influence long-term outcomes, such as survival rates, reduction in complications, and decreased rates of positive surgical margins. There was also a finding that in hospitals with HV of more than 20 RCs per year, postoperative outcomes were even better. Regarding surgeon volume (SV), the available evidence is limited and data shows mixed results. Although some studies suggest that high SV may be associated with better outcomes, many studies conclude that HV has a greater impact on clinical outcomes than SV. The European Association of Urology (EAU) recommends hospitals to perform at least 10 RCs per year, and preferably more than 20 RCs per year to improve



					treatment outcomes.
Comparison of Outcomes in Patients With Muscle-invasive Bladder Cancer Treated With Radical Cystectomy Versus Bladder Preservation [10]	Propensity-score matched analysis using NCDB data; comparison of radical cystectomy vs. BPCRT outcomes	8454 patients with MIBC; 7276 received radical cystectomy, 1178 underwent BPCRT	Comparing outcomes of invasive bladder cancer patients treated with radical cystectomy or bladder preservation therapy through chemoradiotherapy	Age, comorbidities (Charlson-Deyo score), T-stage, facility type, tumor site	The study found that of the 8,454 eligible patients, 86% underwent radical cystectomy, while 14% underwent bladder preservation through chemoradiotherapy. Results from the propensity-matching analysis indicated that there was no significant difference in survival between the two groups (with a median survival of 2.7 years for the bladder preservation group and 3.0 years for the cystectomy group). This analysis also indicated that the hazard ratio of the cystectomy group versus the bladder preservation group decreased over time, with an initial HR of 1.27 that decreased by 0.85 per year. In the bladder preservation group, the therapy involved maximal

transurethral resection of the tumor, followed by concurrent chemoradiotherapy. This study notes that a bladder preservation strategy can be a viable alternative for appropriately selected patients, providing outcomes comparable to radical cystectomy in a real-world context outside of clinical trials.

In evaluating the surgical techniques for managing invasive bladder cancer, open radical cystectomy (ORC), laparoscopic radical cystectomy (LRC), and robotic-assisted radical cystectomy (RARC) have been extensively compared. ORC remains the gold standard for muscle-invasive bladder cancer due to its long-established efficacy in oncological outcomes. However, it is associated with significant perioperative complications, including higher blood loss and longer hospital stays.

Minimally invasive approaches such as LRC and RARC are gaining popularity due to their advantages in perioperative metrics. These techniques are associated with reduced blood loss, lower transfusion rates, shorter hospital stays, and quicker recovery times compared to ORC. Importantly, studies have shown that the oncological outcomes of LRC and RARC are comparable to those of ORC in terms of overall survival (OS), cancer-specific survival (CSS), and recurrence-free survival (RFS). Despite these benefits, LRC has a steep learning

curve, which has limited its widespread adoption compared to RARC.

Several prognostic factors significantly impact patient outcomes following radical cystectomy for bladder cancer. The extent of lymph node dissection (LND) is crucial; more extensive LND is associated with improved staging accuracy and potentially better survival outcomes. Negative surgical margins are another critical factor, as positive margins are linked to poorer CSS and OS.

Hospital and surgeon volume also play a vital role in surgical outcomes. High-volume centers and surgeons tend to achieve better perioperative outcomes, including lower complication rates and improved survival metrics. This is likely due to the increased experience and resources available at such centers, which facilitate high-quality surgical care.

Statistical data from various studies highlight the efficacy of these

surgical techniques. For instance, a study comparing ORC, LRC, and RARC reported no significant differences in OS, CSS, and RFS among the three approaches. The two-year progression-free survival was found to be 72.3% for RARC and 71.6% for ORC, demonstrating non-inferiority of the robotic approach.

Complication rates vary among the techniques; ORC generally has higher intraoperative blood loss and longer hospital stays compared to LRC and RARC. The positive surgical margin rates were similar across techniques, underscoring the importance of surgical precision regardless of the approach. Overall, while ORC remains a robust option with proven long-term outcomes, minimally invasive techniques like LRC and RARC offer comparable oncological results with improved perioperative recovery profiles. The choice of technique should consider patient-specific factors and institutional expertise to optimize outcomes.

Tabel 3 Comparison of Surgical Outcomes for Radical Cystectomy Techniques in Invasive Bladder Cancer

Surgical Technique	Overall Survival (OS)	Cancer - Specific Survival (CSS)	Recurrence -Free Survival (RFS)	Morbidity Rate	Additional Notes
Robot-Assisted Radical Cystectomy (RARC)	Comparable to ORC	Non-inferior to ORC	Reported	Lower complication rates	Good oncological outcomes
Laparoscopic Radical Cystectomy (LRC)	Comparable to ORC	Non-inferior to ORC	Reported	Lower complication rates	Good oncological outcomes
Open Radical Cystectomy (ORC)	Standard of care	Standard of care	Standard of care	Higher complication rates	Requires careful patient selection

Tabel 4 Evaluation of Surgical Techniques and Prognostic Factors in Invasive Bladder Cancer Management

Outcome Measure	Open Cystectomy (ORC)	Radical Cystectomy (LRC)	Laparoscopic Radical Cystectomy (LRC)	Robotic-Assisted Radical Cystectomy (RARC)
Overall Survival (OS)	55% at 3 years; 35% at 10 years	Overall Survival (OS)	55% at 3 years; 35% at 10 years	
Cancer-Specific Survival (CSS)	73% at 3 years; 63% at 10 years	Cancer-Specific Survival (CSS)	73% at 3 years; 63% at 10 years	
Recurrence-Free Survival (RFS)	71% at 3 years; 54% at 10 years	Recurrence-Free Survival (RFS)	71% at 3 years; 54% at 10 years	
Complication Rate	Higher complication rate	Complication Rate	Higher complication rate	
Estimated Blood Loss	Higher than LRC and RARC	Estimated Blood Loss	Higher than LRC and RARC	
Hospital Stay	Longer than LRC and RARC	Hospital Stay	Longer than LRC and RARC	

DISCUSSION

The systematic review highlights significant insights into the comparative effectiveness and safety of various surgical approaches for managing invasive bladder cancer^[11]. Open Radical Cystectomy (ORC) remains the gold standard due to its long-standing efficacy in achieving favorable oncological outcomes, such

as overall survival (OS), cancer-specific survival (CSS), and recurrence-free survival (RFS). However, ORC is associated with higher perioperative morbidity, including increased blood loss and extended hospital stays, which can impact patient recovery and quality of life^[12].

In contrast, minimally invasive techniques such as

Laparoscopic Radical Cystectomy (LRC) and Robotic-Assisted Radical Cystectomy (RARC) have gained traction due to their potential to reduce perioperative complications [13]. These techniques typically result in lower blood loss, reduced transfusion rates, shorter hospital stays, and faster recovery times. Importantly, studies indicate that the oncological outcomes of LRC and RARC are comparable to ORC, making them viable alternatives for selected patients [14].

The preference for certain surgical techniques often depends on patient-specific factors and institutional capabilities. For instance, RARC is increasingly preferred in high-volume centers due to its ergonomic advantages and enhanced precision, which can lead to better perioperative outcomes. However, the steep learning curve associated with LRC has limited its widespread adoption compared to RARC [15].

The choice of surgical technique for managing invasive bladder cancer is influenced by several key factors, including patient

characteristics, institutional expertise, and prognostic factors. Patient characteristics such as age, comorbidities, and personal preferences are crucial in determining the most appropriate surgical approach [16]. Minimally invasive techniques, like laparoscopic and robotic-assisted radical cystectomy, may be preferred for patients who prioritize quicker recovery and reduced postoperative discomfort. These approaches can offer significant benefits in terms of reduced blood loss, shorter hospital stays, and faster return to normal activities, making them particularly attractive to patients with higher surgical risk profiles or those desiring a less invasive procedure [17].

Institutional expertise also plays a significant role in surgical outcomes. The availability of advanced surgical technology and the experience level of the surgical team can significantly impact the success of the procedure. High-volume centers with specialized expertise in robotic-assisted radical cystectomy (RARC) often achieve superior results due to their accumulated

experience and resources. These centers are typically better equipped to handle complex cases and manage perioperative complications effectively, which can lead to improved patient outcomes [18].

Prognostic factors such as the extent of lymph node dissection (LND) and achieving negative surgical margins are critical for optimal outcomes in bladder cancer surgery. Extensive LND is associated with improved staging accuracy and potentially better survival outcomes, while negative surgical margins are essential for reducing the risk of cancer recurrence [19]. These factors are important regardless of the surgical approach chosen, underscoring the need for meticulous surgical planning and execution to optimize oncological outcomes. Overall, the selection of a surgical technique should be a carefully considered decision that balances patient-specific factors with institutional capabilities to achieve the best possible results [20].

The systematic review findings have significant implications for clinical practice in the surgical

management of invasive bladder cancer. The evidence strongly suggests that surgical approach selection should be individualized based on both patient characteristics and institutional capabilities. For high-volume centers with robotic surgery expertise, RARC presents a viable alternative to ORC, offering comparable oncological outcomes with potential benefits in perioperative recovery.

Patient selection criteria should consider multiple factors including age, comorbidities, body mass index, and tumor characteristics. Elderly patients and those with significant comorbidities may particularly benefit from minimally invasive approaches due to reduced blood loss and shorter hospital stays. However, patients with locally advanced disease or complex reconstruction needs may be better served by ORC, especially in centers with extensive open surgery experience.

Institutional factors play a crucial role in surgical outcomes. Centers performing at least 10 radical cystectomies annually, and preferably

20 or more, demonstrate superior outcomes in terms of perioperative mortality and oncological results. This suggests that centralization of bladder cancer surgery to high-volume centers may optimize patient outcomes. For facilities unable to maintain these volumes, establishing referral networks with high-volume centers should be considered.

CONCLUSION

This systematic review has highlighted the critical role of surgical intervention in managing muscle-invasive bladder cancer (MIBC). The findings underscore that while open radical cystectomy (ORC) remains the gold standard due to its established efficacy in achieving favorable oncological outcomes, minimally invasive techniques such as laparoscopic radical cystectomy (LRC) and robotic-assisted radical cystectomy (RARC) are gaining traction. These minimally invasive approaches offer comparable oncological outcomes to ORC, including overall survival (OS), cancer-specific survival (CSS), and recurrence-free survival (RFS), while

significantly reducing perioperative complications such as blood loss and hospital stay duration. The importance of high-quality surgery is emphasized, as factors like negative surgical margins and extensive lymph node dissection are crucial for optimizing patient outcomes.

Future research should focus on validating these findings through prospective studies that can provide more robust data on the long-term outcomes of different surgical approaches. Additionally, there is a need to explore emerging techniques such as enhanced recovery after surgery (ERAS) protocols, which have shown promise in improving postoperative recovery by reducing hospital stays and enhancing patient comfort without compromising oncological outcomes. These protocols could be further refined and adapted specifically for bladder cancer surgeries to maximize their benefits. Moreover, ongoing advancements in robotic surgery technology should be monitored to assess their impact on surgical precision and patient outcomes. As surgical techniques continue to

evolve, it is imperative that future studies also consider the economic implications of adopting new technologies, ensuring that improvements in care do not come at an unsustainable cost.

DISCLOSURE STATEMENT

Disclosure Statement : The authors have no conflicts of Interest to declare.

REFERENCES

- [1] J. J. Meeks et al., "A Systematic Review of Neoadjuvant and Adjuvant Chemotherapy for Muscle-invasive Bladder Cancer," *Eur Urol*, vol. 62, no. 3, pp. 523–533, Sep. 2012, doi: 10.1016/j.eururo.2012.05.048.
- [2] J. Wu, R.-Y. Xie, C.-Z. Cao, B.-Q. Shang, H.-Z. Shi, and J.-Z. Shou, "Disease Management of Clinical Complete Responders to Neoadjuvant Chemotherapy of Muscle-Invasive Bladder Cancer: A Review of Literature," *Front Oncol*, vol. 12, Apr. 2022, doi: 10.3389/fonc.2022.816444.
- [3] G. Gakis et al., "ICUD-EAU International Consultation on Bladder Cancer 2012: Radical Cystectomy and Bladder Preservation for Muscle-Invasive Urothelial Carcinoma of the Bladder," *Eur Urol*, vol. 63, no. 1, pp. 45–57, Jan. 2013, doi: 10.1016/j.eururo.2012.08.009.
- [4] G. Arcangeli, L. Strigari, and S. Arcangeli, "Radical cystectomy versus organ-sparing trimodality treatment in muscle-invasive bladder cancer: A systematic review of clinical trials," *Crit Rev Oncol Hematol*, vol. 95, no. 3, pp. 387–396, Sep. 2015, doi: 10.1016/j.critrevonc.2015.04.006.

- [5] R. Ghandour, N. Singla, and Y. Lotan, "Treatment Options and Outcomes in Nonmetastatic Muscle Invasive Bladder Cancer," *Trends Cancer*, vol. 5, no. 7, pp. 426–439, Jul. 2019, doi: 10.1016/j.trecan.2019.05.011.
- [6] D. C. Snow-Lisy et al., "Robotic and Laparoscopic Radical Cystectomy for Bladder Cancer: Long-term Oncologic Outcomes," *Eur Urol*, vol. 65, no. 1, pp. 193–200, Jan. 2014, doi: 10.1016/j.eururo.2013.08.021.
- [7] T. H. Kim et al., "Oncological Outcomes in Patients Treated with Radical Cystectomy for Bladder Cancer: Comparison Between Open, Laparoscopic, and Robot-Assisted Approaches," *J Endourol*, vol. 30, no. 7, pp. 783–791, Jul. 2016, doi: 10.1089/end.2015.0652.
- [8] M. Pere, A. Amantakul, S. Sriplakich, and T. Tarin, "Optimizing surgical outcomes in bladder cancer patients undergoing radical cystectomy," *Front Surg*, vol. 9, Mar. 2023, doi: 10.3389/fsurg.2022.1008318.
- [9] H. M. Bruins et al., "The Importance of Hospital and Surgeon Volume as Major Determinants of Morbidity and Mortality After Radical Cystectomy for Bladder Cancer: A Systematic Review and Recommendations by the European Association of Urology Muscle-invasive and Metastatic Bladder Cancer Guideline Panel," *Eur Urol Oncol*, vol. 3, no. 2, pp. 131–144, Apr. 2020, doi: 10.1016/j.euo.2019.11.005.
- [10] J. Zhong et al., "Comparison of Outcomes

- in Patients With Muscle-invasive Bladder Cancer Treated With Radical Cystectomy Versus Bladder Preservation,” *Am J Clin Oncol*, vol. 42, no. 1, 2019, [Online]. Available: https://journals.lww.com/amjclinicaloncology/fulltext/2019/01000/comparison_of_outcomes_in_patients_with.7.aspx
- [11] J. C. Hu et al., “Perioperative Outcomes, Health Care Costs, and Survival After Robotic-assisted Versus Open Radical Cystectomy: A National Comparative Effectiveness Study,” *Eur Urol*, vol. 70, no. 1, pp. 195–202, Jul. 2016, doi: 10.1016/j.eururo.2016.03.028.
- [12] D. J. Parekh et al., “Robot-assisted radical cystectomy versus open radical cystectomy in patients with bladder cancer (RAZOR): an open-label, randomised, phase 3, non-inferiority trial,” *The Lancet*, vol. 391, no. 10139, pp. 2525–2536, Jun. 2018, doi: 10.1016/S0140-6736(18)30996-6.
- [13] K. Matsumoto et al., “Robot-assisted laparoscopic radical cystectomy is a safe and effective procedure for patients with bladder cancer compared to laparoscopic and open surgery: Perioperative outcomes of a single-center experience,” *Asian J Surg*, vol. 42, no. 1, pp. 189–196, Jan. 2019, doi: 10.1016/j.asjsur.2017.11.002.
- [14] B. J. Challacombe et al., “The Role of Laparoscopic and Robotic Cystectomy in the Management of Muscle-Invasive Bladder Cancer With Special Emphasis on Cancer Control and Complications,” *Eur Urol*, vol. 60, no. 4, pp. 767–775, Oct. 2011, doi:

- 10.1016/j.eururo.2011.05.012.
- [15] P. Adamczyk, K. Juszcak, M. Kadłubowski, A. Ostrowski, P. Maciukiewicz, and T. Drewa, "Can laparoscopic cystectomy become the method of choice in the treatment of invasive urothelial urinary bladder cancer?," *Advances in Clinical and Experimental Medicine*, vol. 29, no. 3, pp. 301–304, Mar. 2020, doi: 10.17219/acem/115084.
- [16] A. G. Bachman et al., "Minimally Invasive Versus Open Approach for Cystectomy: Trends in the Utilization and Demographic or Clinical Predictors Using the National Cancer Database," *Urology*, vol. 103, pp. 99–105, May 2017, doi: 10.1016/j.urology.2017.02.018.
- [17] J. P. Stein et al., "Radical Cystectomy in the Treatment of Invasive Bladder Cancer: Long-Term Results in 1,054 Patients," *Journal of Clinical Oncology*, vol. 19, no. 3, pp. 666–675, Feb. 2001, doi: 10.1200/JCO.2001.19.3.666.
- [18] A. B. Smith et al., "Multi-Institutional Analysis of Robotic Radical Cystectomy for Bladder Cancer: Perioperative Outcomes and Complications in 227 Patients," *Journal of Laparoendoscopic & Advanced Surgical Techniques*, vol. 22, no. 1, pp. 17–21, Jan. 2012, doi: 10.1089/lap.2011.0326.
- [19] Z. A. Dotan et al., "Positive Surgical Margins in Soft Tissue Following Radical Cystectomy for Bladder Cancer and Cancer Specific Survival," *Journal of Urology*, vol. 178, no. 6,

- pp. 2308–2313, Dec. 2007,
doi:
10.1016/j.juro.2007.08.023
- [20] D. Canter et al., “A
Thorough Pelvic Lymph
Node Dissection in
Presence of Positive
Margins Associated With
Better Clinical Outcomes
in Radical Cystectomy
Patients,” *Urology*, vol. 74,
no. 1, pp. 161–165, Jul.
2009, doi:
10.1016/j.urology.2009.01.
024.

