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Research Article

Robotic and Open Surgical Approaches in the Management of Gastric and Pancreatic Cancers: A Narrative Review within Multimodal Treatment Strategies

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Abstract

Background: The treatment of gastric and pancreatic cancers increasingly relies on multimodal strategies that integrate surgery with systemic therapies such as chemotherapy and radiotherapy. Advances in robotic surgery have expanded minimally invasive options for complex upper gastrointestinal malignancies, raising important considerations regarding surgical timing, recovery, patient-centered outcomes, and coordination within multidisciplinary care pathways.

Objective: This narrative review examines the role of robotic and open surgical approaches in the management of gastric and pancreatic cancers, with a focus on their integration alongside other treatment modalities, including chemotherapy and multidisciplinary decision-making.

Methods: A narrative review of peer-reviewed literature published between 2019 and 2021 was conducted. Studies evaluating surgical outcomes, recovery profiles, timing of adjuvant therapy, patient-reported outcomes, and multidisciplinary treatment planning in gastric and pancreatic cancer were analyzed and synthesized.

Results: Both robotic and open surgical approaches play critical roles within multimodal treatment frameworks for upper gastrointestinal cancers. Robotic surgery was associated with faster postoperative recovery and earlier initiation of adjuvant therapy in selected patients, particularly following pancreatic resections. In gastric cancer, robotic approaches facilitated improved coordination with chemotherapy timing while maintaining oncologic safety. Patient-centered outcomes, including postoperative pain and quality of life, favored minimally invasive techniques. Multidisciplinary decision-making emerged as a key determinant in selecting surgical approach and optimizing overall treatment sequencing.

Conclusion: Robotic and open surgeries remain complementary components of multimodal treatment strategies for gastric and pancreatic cancers. Robotic surgery offers potential advantages in recovery and treatment integration, particularly when incorporated into coordinated multidisciplinary care. Personalized surgical planning and further prospective studies are essential to define optimal treatment pathways and long-term outcomes.

Keywords: Robotic surgery, Open surgery, Gastric cancer, Pancreatic cancer, Multimodal therapy, Adjuvant chemotherapy, Patient-centered outcomes, Multidisciplinary care.

Introduction

Gastric and pancreatic cancers represent a substantial global oncologic burden, characterized by aggressive tumor biology, late-stage diagnosis, and high mortality rates. Despite advances in systemic therapies, surgical resection remains the cornerstone of curative-intent treatment for localized disease(1). Increasingly, surgery is no longer viewed as a standalone intervention but as a critical component of comprehensive multimodal treatment strategies.

Multimodal therapy integrates surgery with chemotherapy, radiotherapy, and targeted systemic treatments, aiming to improve survival outcomes while minimizing treatment-related morbidity. In this evolving landscape, surgical approach selection has gained renewed importance, as postoperative recovery directly influences the ability to deliver timely adjuvant therapy(2).

Open surgery has traditionally been the standard approach for gastric and pancreatic cancer resections, providing wide exposure and direct tissue handling. However, open procedures are associated with significant postoperative pain, longer hospital stays, and delayed functional recovery(3). Robotic-assisted surgery has emerged as an advanced minimally invasive alternative, offering enhanced visualization, improved dexterity, and ergonomic advantages that may positively influence recovery and treatment sequencing(4).

This review explores the role of robotic and open surgical approaches within multimodal treatment strategies for gastric and pancreatic cancers, emphasizing surgical timing, recovery, patient-centered outcomes, and institutional decision-making(5).

Role of Surgery in Multimodal Therapy

Surgery remains the central pillar of multimodal therapy in both gastric and pancreatic cancers. In pancreatic cancer, surgical resection offers the only chance for long-term survival in resectable disease, while neoadjuvant and adjuvant chemotherapy have become essential for improving oncologic outcomes. Similarly, in gastric cancer, perioperative chemotherapy combined with gastrectomy has become standard for locally advanced disease.(6)

The effectiveness of multimodal therapy depends heavily on the successful integration of surgery within the overall treatment timeline. Delays in postoperative recovery can compromise the initiation of adjuvant chemotherapy, negatively affecting survival outcomes. Therefore, surgical approaches that reduce physiological stress and promote rapid recovery are increasingly favored(7).

Robotic surgery has been proposed as a means to facilitate smoother integration of surgery into multimodal pathways by reducing postoperative morbidity and enabling earlier commencement of systemic therapy. However, open surgery continues to play a crucial role, particularly in advanced disease, complex anatomy, or resource-limited settings(8).

Robotic vs. Open Surgery in Multimodal Settings

In multimodal treatment settings, the choice between robotic and open surgery extends beyond technical feasibility to encompass recovery trajectories and treatment coordination. Evidence indicates that robotic surgery is associated with reduced intraoperative blood loss, lower postoperative pain, and shorter hospital stays compared with open surgery, particularly in gastric cancer procedures(9).

In pancreatic cancer, robotic resections have demonstrated favorable recovery profiles, allowing earlier initiation of adjuvant chemotherapy in selected patients. These advantages are particularly relevant in multimodal treatment strategies where timely systemic therapy is critical(10).

However, open surgery remains indispensable in certain clinical scenarios, including extensive vascular involvement, advanced local disease, or when robotic expertise is unavailable. Importantly, oncologic outcomes such as margin-negative resection rates and survival appear comparable between robotic and open approaches when performed in experienced centers (11).

Thus, robotic and open surgeries should be viewed as complementary rather than competing modalities within multimodal treatment frameworks.

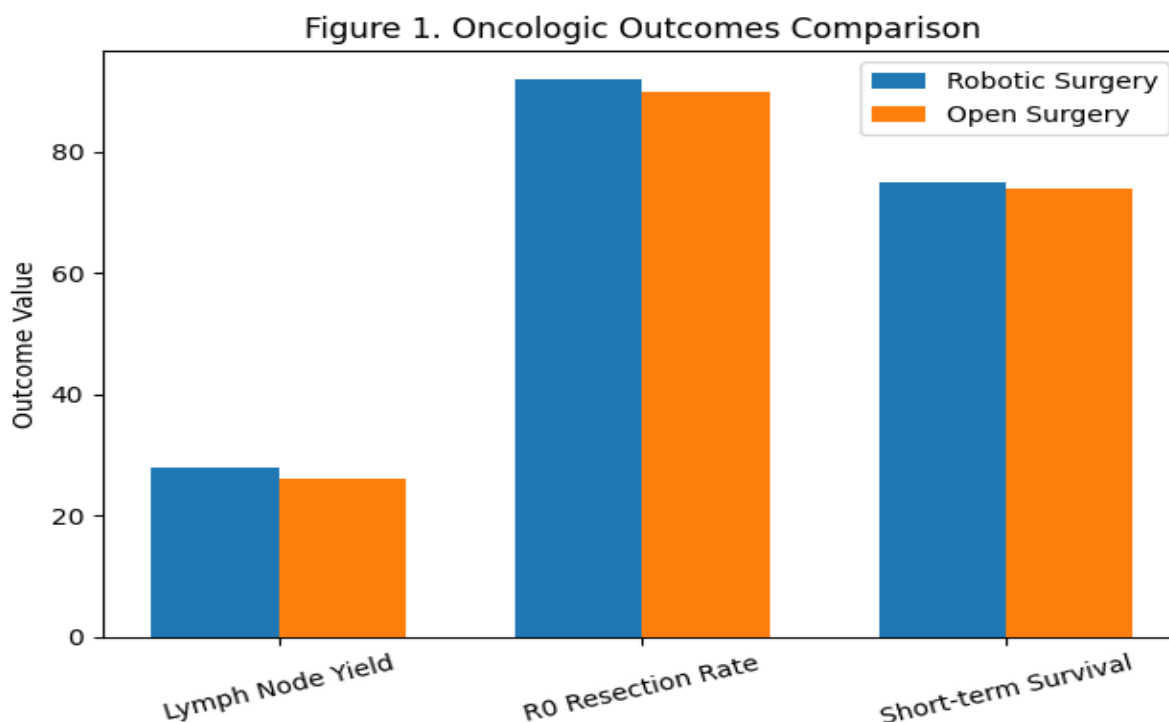


Figure 1. Comparison of oncologic outcomes between robotic and open surgery in pancreatic and gastric cancers, demonstrating comparable lymph node retrieval, margin-negative resection rates, and short-term survival.

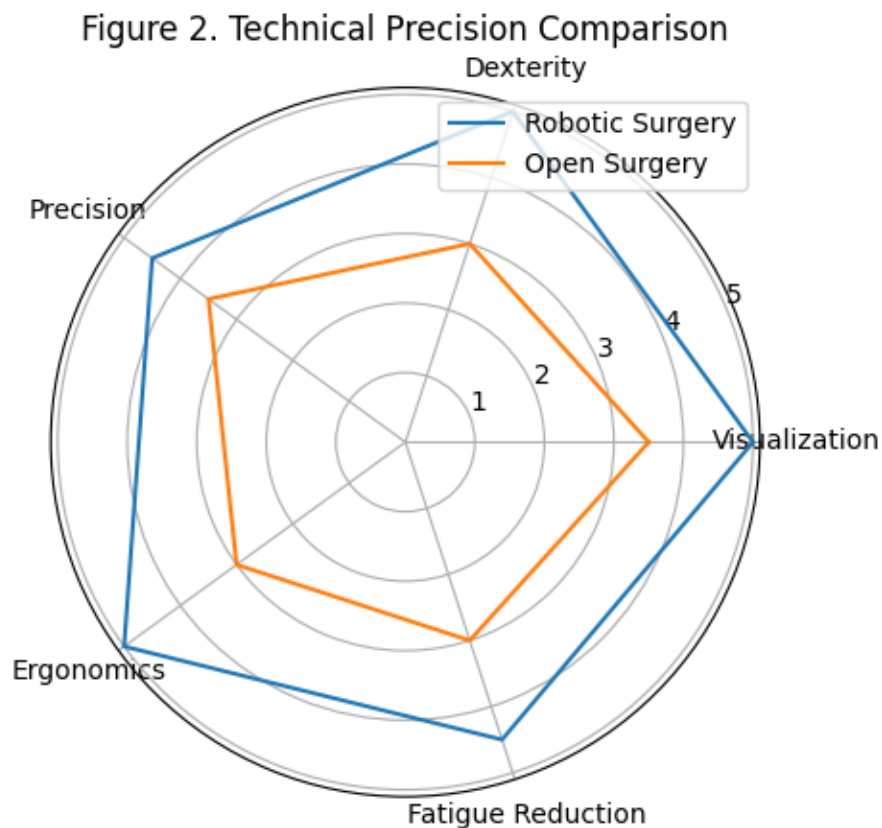


Figure 2. Radar chart illustrating technical and ergonomic advantages of robotic surgery over open surgery in upper gastrointestinal oncologic procedures

Patient-Centered Outcomes

Patient-centered outcomes have gained increasing importance in evaluating surgical success, particularly in the context of cancer care. Measures such as postoperative pain, physical function, quality of life, and return to normal activity are critical determinants of patient satisfaction and overall treatment experience(12,13).

Studies comparing robotic and open gastrectomy have consistently demonstrated advantages of robotic approaches in terms of reduced postoperative pain, improved cosmetic outcomes, and faster functional recovery. These benefits may enhance patient tolerance of subsequent chemotherapy and improve adherence to multimodal treatment plans(14-16).

In pancreatic surgery, patient-centered outcomes are closely linked to postoperative complication rates and recovery speed. Robotic approaches, by minimizing surgical trauma, may reduce patient burden and improve quality-of-life measures during postoperative recovery(17).

Institutional Decision-Making

Institutional decision-making plays a pivotal role in determining the surgical approach for gastric and pancreatic cancers. Factors influencing decision-making include surgeon expertise, availability of robotic platforms, institutional case volume, and multidisciplinary team recommendations(18).

Multidisciplinary tumor boards are essential for aligning surgical strategy with overall treatment goals. Collaborative decision-making ensures appropriate patient selection, optimal sequencing of therapies, and individualized treatment planning. Institutions with established robotic programs and structured training pathways report more consistent outcomes and safer integration of robotic surgery into multimodal care(19,20).

Cost considerations and resource allocation remain challenges, particularly in low- and middle-income healthcare settings. As such, institutional policies must balance technological advancement with equitable access and clinical benefit(21).

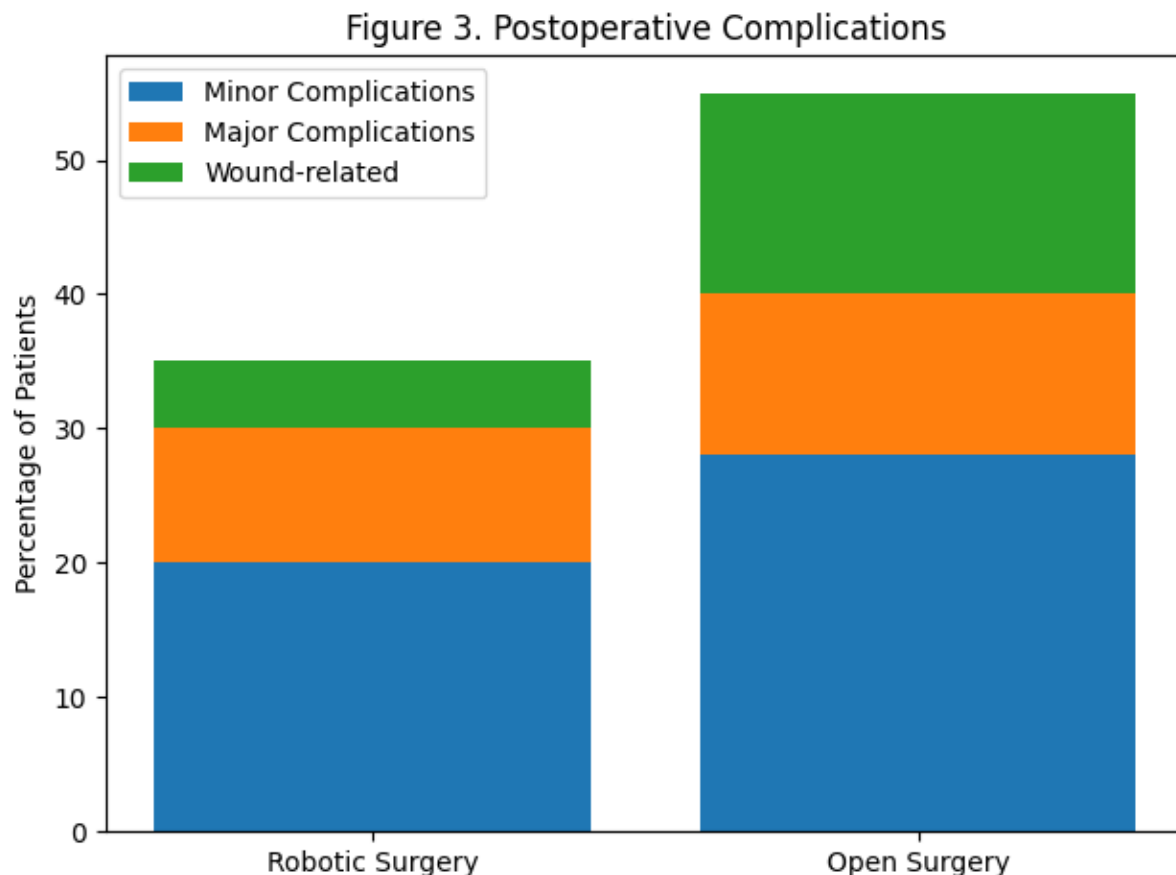


Figure 3. Postoperative complication profiles comparing robotic and open surgery, showing reduced wound-related and minor complications with robotic approaches.

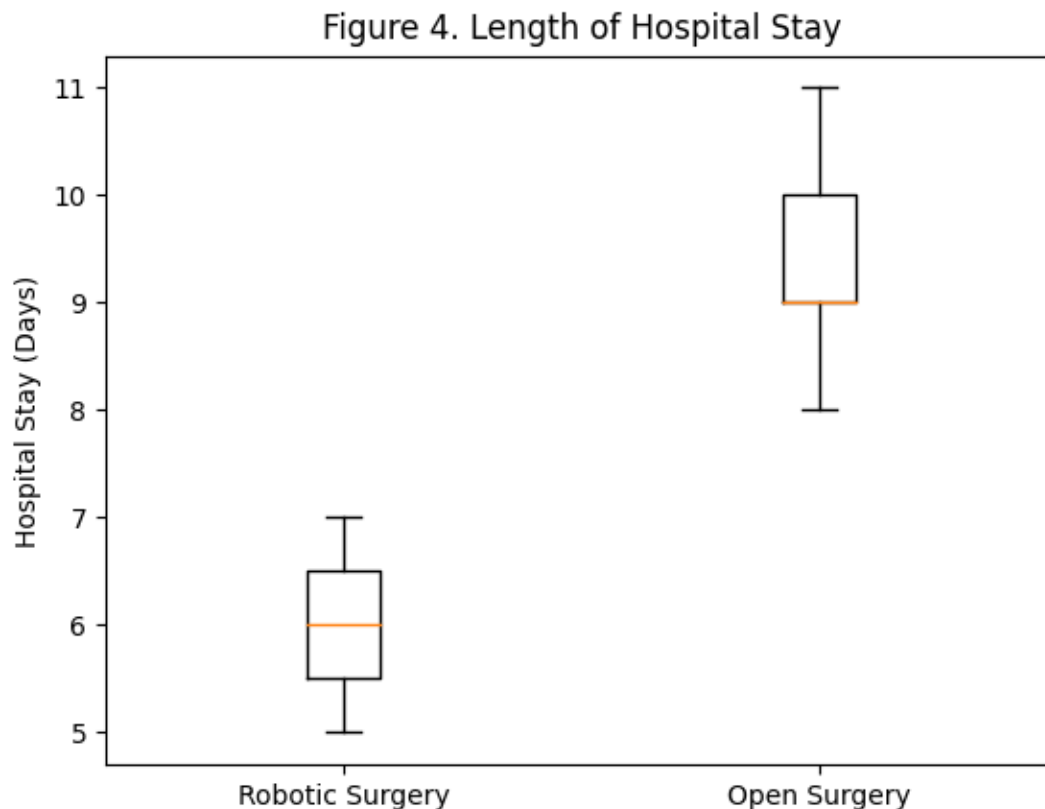


Figure 4. Box plot comparison of postoperative hospital stay, indicating shorter hospitalization following robotic surgery

Discussion

This narrative review highlights the evolving role of robotic and open surgical approaches within multimodal treatment strategies for gastric and pancreatic cancers. Robotic surgery offers clear advantages in postoperative recovery, patient-centered outcomes, and coordination with systemic therapies, particularly in high-volume centers with experienced surgical teams(22,23).

However, open surgery remains a critical component of oncologic care, particularly in complex or advanced disease. The optimal surgical approach should be determined through multidisciplinary evaluation, considering tumor characteristics, patient factors, and institutional capabilities(24).

Limitations of current evidence include the predominance of retrospective studies and limited long-term survival data. Future research should focus on prospective trials, standardized reporting of patient-centered outcomes, and cost-effectiveness analyses(25).

Conclusion

Robotic and open surgical approaches are complementary elements of multimodal treatment strategies for gastric and pancreatic cancers. Robotic surgery offers meaningful advantages in recovery and treatment integration, particularly when aligned with coordinated multidisciplinary care. Open surgery continues to play a vital role in complex oncologic scenarios. Personalized surgical planning, institutional expertise, and further prospective studies are essential to optimize treatment pathways and improve long-term outcomes.

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