

## ADVANCES IN SURGICAL TECHNIQUES FOR THE TREATMENT OF LIVER TUMORS: A BIBLIOGRAPHICAL REVIEW

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**Abstract:** Objective: This study aims to provide a comprehensive overview of surgical practices and locoregional therapies used in the treatment of liver tumors, highlighting their clinical applications, benefits and challenges. Method: A detailed literature review was carried out using the PubMed database, with the search terms “Hepatectomy”, “Liver tumors”, and “Hepatic neoplasms”. After applying strict inclusion and exclusion criteria, 14 articles were selected for analysis. Results: The results indicate significant advances in laparoscopic procedures, allowing the development of complex laparoscopic liver resection (LLR) techniques. These techniques have proven to be safe and viable for the treatment of malignant liver tumors, including extensive hepatectomies and tumors located in challenging regions. Conclusion: The improvement of LLR techniques represents notable progress in the treatment of liver neoplasms, offering lower postoperative morbidity and faster recovery for patients. However, challenges remain related to the necessary technical training and the management of tumors in difficult-to-access locations.

**Keywords:** Hepatectomy, Laparotomy, Neoplasms.

## INTRODUCTION

In recent years, liver surgery has experienced significant advances, especially in the treatment of benign and malignant liver tumors. Laparoscopic liver resection has been highlighted for its superiority compared to open liver resection for benign tumors, offering advantages such as less invasiveness and faster recovery (Wabitsch et al., 2019). Furthermore, radioembolization has emerged as a valuable tool in preparing for surgical procedures in patients with advanced tumors (Aliseda et al., 2023).

However, the high mortality rate and

postoperative complications remain significant challenges, highlighting the need for continued innovation in the field (Hu & Shen, 2021).

Precision surgery, an advancement in surgical practice, has been crucial to optimizing therapeutic results and minimizing complications. This approach emphasizes the importance of precise and less invasive surgical techniques, such as laparoscopic liver surgery, which has gained preference due to its lower morbidity profile (Hu & Shen, 2021).

The introduction of minimally invasive techniques, including indocyanine green fluorescence-guided hepatectomy, represents significant progress, offering improved safety and efficacy in tumor removal. These innovations are transforming the field of liver surgery, enabling safer and more effective interventions (Ng, 2023).

Hepatocellular carcinoma (HCC) remains the most common primary malignancy of the liver, and innovations in surgical techniques have a profound impact on patients' quality of life after surgery. New surgical modalities, such as laparoscopic hepatectomy, robotics, and video-assisted techniques, in addition to the use of intraoperative MRI and radiofrequency ablation, are among the most promising advances (Wabitsch et al., 2019).

This study aims to conduct a comprehensive review of recent literature to analyze and synthesize contemporary approaches to hepatectomy for the treatment of liver tumors. The review will focus on highlighting innovative surgical techniques, applied technological advances, and the challenges and clinical outcomes associated with these interventions. In short, the objective is to provide a comprehensive overview of the surgical practices and locoregional therapies currently employed in the treatment of liver tumors, exploring their clinical applications, benefits and challenges.

## METHODOLOGY

This bibliographic review was structured following the PVO strategy, which considers the Population or research problem, the Variables involved and the expected Outcome. The research was guided by the following guiding question: "What are the most recent and effective approaches to hepatectomy in the context of liver tumor removal, considering surgical techniques, technological advances and associated challenges, as evidenced by current scientific literature?"

The searches were carried out in the PubMed - MEDLINE (Medical Literature Analysis and Retrieval System Online) databases, using health science descriptors combined with Boolean operators. The search strategy adopted was: ("Hepatectomy" AND ("Liver tumors" OR "Hepatic neoplasms")). This initial search identified 1,350 articles.

The inclusion criteria applied were: articles in English and Portuguese, published between 2019 and 2024, that addressed the proposed themes. Meta-analysis studies, observational studies and experimental studies were selected, all available in full. Exclusion criteria included: duplicate articles, publications available only in summary form, and articles that did not directly address the topic investigated or that did not meet the other inclusion criteria.

After rigorous application of the inclusion and exclusion criteria, the total number of articles was reduced to 329. From this set, 14 articles were finally selected to compose the collection of this study. This careful selection ensured a comprehensive and up-to-date review of the most recent and effective surgical approaches for hepatectomy in patients with liver tumors, highlighting technological innovations and challenges faced in modern surgical practice.

## DISCUSSION

### ADVANCED SURGICAL TECHNIQUES IN HEPATECTOMY

Hepatectomies, despite being historically associated with high rates of mortality and disease recurrence, have witnessed a significant evolution in surgical techniques, resulting in a reduction in mortality to less than 5% and a survival rate of approximately 70% in five years for patients with asymptomatic tumors and good liver function. Still, tumor recurrence represents a considerable challenge, occurring in up to 50% of cases within three years, even among carefully selected cases (Rodrigues et al., 2017).

Minimally invasive surgery, particularly laparoscopic hepatectomy, stands out compared to the conventional open approach. This technique offers multiple advantages, such as shorter hospital stays, reduced postoperative pain, better aesthetic results and faster recovery (Sucandy et al., 2019; Sucandy et al., 2020; Xuea et al., 2023). Comparative studies have demonstrated that the laparoscopic approach is associated with less blood loss, less need for transfusion, reduced length of stay, and lower 30-day mortality rate (Sucandy et al., 2019).

Despite the clear benefits, widespread adoption of the laparoscopic technique faces obstacles due to its technical complexity and challenging learning curve. The limitations inherent to the laparoscopic technique, such as the fulcrum effect and restrictions on instrument movements, have been overcome with the introduction of robotic systems. These offer a high-definition, three-dimensional view and greater range of motion, providing clear benefits in delicate procedures involving the hepatic hilum and major vascular structures such as the inferior vena cava and portal vein (Sucandy et al., 2019).

Among the innovations, robotic liver surgery represents the pinnacle of minimally invasive techniques, standing out for features such as expanded three-dimensional vision, elimination of physiological tremor, improved dexterity with seven degrees of freedom, ease of suturing and a superior range of motion. These characteristics contribute to a shorter length of hospital stay, reduced postoperative pain and a faster return to preoperative activities (Sucandy et al., 2020; Xuea et al., 2023; Rodrigues et al., 2017).

Although there are still uncertainties, the laparoscopic technique is generally preferred over the open approach due to advantages such as shorter procedures and lower incidence of complications. Robotic surgery, although comparable to laparoscopy in terms of length of stay and complication rate, consistently demonstrates a significant reduction in blood loss, offering a promising prospect for continued improvement in surgical outcomes in hepatectomies (Xuea et al., 2023; Rodrigues et al., 2017).

Hepatectomy, traditionally performed by open surgery, faced high rates of mortality and disease recurrence. Currently, with the advancement of surgical techniques, liver resection for tumors has a mortality risk of less than 5% and a survival rate of approximately 70% in five years for patients with asymptomatic tumors and good liver function. However, tumor recurrence remains a significant challenge, with an incidence of up to 50% within three years after surgery, even in carefully selected cases (Rodrigues et al., 2017).

Minimally invasive surgery has emerged as a superior alternative to the conventional open approach, offering benefits such as reduced hospital stays, decreased postoperative pain, better aesthetic results, and a quicker return to daily activities (Sucandy et al., 2020; Xuea et al., 2023). A comparison of methods

demonstrated that laparoscopic liver surgeries are associated with less blood loss, reduced need for transfusions, and reduced length of stay and 30-day mortality (Sucandy et al., 2020).

However, many surgeons are reluctant to adopt the laparoscopic technique widely due to its technical complexity and challenging learning curve. The technical limitations of laparoscopic surgeries, such as the fulcrum effect and restrictions on instrument movements, have been overcome by the advent of robotic systems. These systems offer high-definition three-dimensional vision, greater range of motion and instruments with internal articulation, providing advantages during procedures close to critical vascular structures such as the hepatic hilum (Sucandy et al., 2020).

### **IMPACT OF TECHNOLOGICAL ADVANCES ON THE EFFICIENCY AND SAFETY OF HEPATECTOMY**

Advances in liver surgery are driven by the need for methods that can identify patients for intensive postoperative follow-up or exclude those at high surgical risk. The American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) score is a useful tool for stratifying postoperative risk and estimating morbidity and mortality. However, the accuracy of this score may be limited by the absence of organ-specific risk factors, tumor size, and residual volume of functional liver tissue. Therefore, although the ACS-NSQIP is important, its use must be cautious, and patients undergoing surgery at institutions using this score must be fully informed to align their expectations (Donadon et al., 2020).

In the context of treating malignant liver tumors, hepatic division such as hepatic artery occlusion, ALPPS and two-stage hepatectomy stands out for minimizing postoperative risks,

such as renal failure, by allowing recovery of the organ before the second resection. These methods are accepted in current medical practice and have improved disease-free survival rates (Albati et al., 2019).

Minimally invasive surgery, including videolaparoscopy, has been shown to be effective in reducing bleeding, transaminase elevations, intraoperative blood loss and length of hospital stay in cases of recurrent tumors. It is important to note that minimally invasive procedures, regardless of the extent of resection, are associated with lower rates of thromboembolic events (Chen et al., 2021; Hue et al., 2021).

Since the introduction of Laparoscopic Liver Resection (LLR) in 1996 by Azagra et al., the technique has become a primary choice for many patients with liver tumors due to advances in surgical techniques, anesthesiology and perioperative care. Accumulated experience with laparoscopic procedures has allowed the development of complex laparoscopic liver resection techniques, demonstrating the safety and feasibility of LLR for malignant tumors, major hepatectomies, and tumors in unfavorable locations (Lan et al., 2022; Lo; Young; Andrew Difronzo, 2020).

### **FINAL CONSIDERATIONS**

This study provides a detailed analysis of recent advances in liver surgery, especially in hepatectomy techniques for treating liver tumors. Of note is the growing adoption of minimally invasive procedures, such as laparoscopic and robotic hepatectomy, and innovative approaches such as ALPPS and radioembolization, which improve therapeutic results and reduce postoperative complications. Minimally invasive techniques provide benefits such as reduced hospital stay, less postoperative pain and accelerated recovery. Advances such as intraoperative MRI



and radiofrequency ablation have increased the safety and effectiveness of tumor removal. Robotic surgery offers advantages such as better vision and precision, contributing to better surgical results and lower morbidity.

However, challenges such as tumor recurrence and limited access to robotic technology reinforce the need for continuous innovation and improvement of adjuvant techniques and therapies.

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